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UNITED STATES NAVY SAFETY PRECAUTIONS



OPNAV 34P1

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UNITED STATES NAVY SAFETY PRECAUTIONS

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INSTRUCTIONS

1. **Forwarding of Recommended Revisions.** Recommendations for additional precautions, for deletions, and for revision of precautions herein published should be addressed to the Chief of Naval Operations (attention OP 342), through the regular chain of command.
2. **Distribution of Separate Chapters.** The loose-leaf format of this publication makes possible the distribution by commanding officers of individual chapters where they are most needed. However, because of the arrangement of these safety precautions, such separation is not recommended unless related chapters are included or unless the remainder of the chapters are available for the looking-up of cross references.
3. **Entering of Changes.** Changes shall be entered in this publication as soon as they are received and their entry recorded in the columns below.
4. **Changes for Chapters Distributed Separately.** If separate chapters or groups of chapters of *Safety Precautions* are issued or reprinted for use by subordinate organizations, it is the responsibility of the command concerned that a record be kept of such internal distribution and that changes be forwarded to all chapter holders.

RECORD OF REVISIONS

[illegible]

THE SECRETARY OF THE NAVY

WASHINGTON, D. C.

8 June 1953

The safety of its personnel and the preservation of its materials have always been a major concern of the Navy Department. Evidence of this is the provision in Article 0406 of *U. S. Navy Regulations*, that "Each Naval Technical Assistant shall prepare and issue to the Naval Establishment the safety precautions, and instructions pertaining thereto, which are necessary or appropriate in connection with matters under his technical control."

Although the foregoing requirement has been complied with faithfully, to date the specific precautions have remained uncoded in a Navy-wide sense and have been obtainable only through reference to a great number and variety of directives and publications. It was in an effort to overcome such dispersal of vital information that the Secretary of the Navy directed on 30 January 1948 that the precautions be "codified and systematized with the view to their promulgation to the service in a single publication approved by the Secretary of the Navy." The present publication, a result of that directive, is hereby promulgated for the entire Naval Establishment, both military and civilian, afloat and ashore.

In recognition of the burden of responsibility which a commanding officer has for the personnel and material under his command, a governing article, 01104 Basic Rule of Responsibility, has been included to allow for adjustments to local conditions and unusual circumstances. The complete text of this article not only appears in Chapter 1, but is reprinted on the title page of each chapter of the book.

It will be observed that the publication is not divided into chapters on the basis of bureau cognizance. Rather its chapter titles are functional—that is, they describe work or duty performed, machinery and equipment operated, or materials involved. This arrangement was adopted because of (1) the widespread duplication of many of the precautions by several bureaus and (2) the overlapping of cognizance in several areas.

The application of these precautions in the Fleets and at shore establishments can be expected to reveal omissions as well as the need for modifications. *U. S. Navy Safety Precautions* is designed to accommodate such changes and additions, and recommendations are invited.



C. S. Thomas
Acting Secretary of the Navy

United States Navy Safety Precautions,
OPNAV 34P1, was prepared in the Office of
the Chief of Naval Operations with the col-
laboration of the technical assistants in the
various bureaus and offices of the Depart-
ment of the Navy.

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United States Navy SAFETY PRECAUTIONS

Chapter I INTRODUCTION

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Chapter I
INTRODUCTION

Section I
BASIC PRECEPTS

Objectives, 01101
Purpose of Publication, 01102

Scope, 01103
Basic Rule of Responsibility, 01104

01101 OBJECTIVES

1. **Welfare of Personnel.** The Department of the Navy maintains a consistent policy of furthering the health and welfare of both military and civilian personnel. While it is recognized that risks are unavoidable during combat, it is emphasized in this volume that injuries, health impairment, and loss of life can be kept to a minimum through the use of safety precautions. Most accidents which occur in noncombat operations can be prevented if the full cooperation of personnel is gained and vigilance is exercised to eliminate unsafe conditions and unsafe acts.

2. **Safety Program.** In accordance with the Navy policy of conserving manpower and material, all naval activities shall conduct effective and continuous accident prevention programs. Operating procedures and work methods shall be adopted which do not expose personnel unnecessarily to injury or occupational health hazards. Instruction in appropriate safety precautions shall be given by all commands, and disciplinary action taken in case of willful violations.

01102 PURPOSE OF PUBLICATION

Experience has shown that an aggressive and comprehensive program of safety engineering and industrial hygiene reduces the number of injuries and occupational diseases. An effective safety and health program includes the dissemination, in one central and authoritative publication for ready reference,

of those safety precautions which will be instrumental in avoiding preventable accidents and in maintaining a work environment which is conducive to good health. It is with this purpose in mind that this publication is promulgated by the Secretary of the Navy for the indoctrination of personnel in the Navy, and others in Navy employment.

01103 SCOPE OF THIS PUBLICATION

1. **Applicability.** The safety precautions contained in this publication are promulgated for the protection of military and civilian personnel in all parts of the Naval Establishment.

2. **Shipboard Safety.** In most instances the hazards involved and the applicable precautions for a given type of work are the same whether the work is done afloat or ashore. **Precautions afloat are therefore not presented separately from precautions ashore except when they concern specific shipboard activities or conditions.**

3. **Functional Organization.** Chapter 1 presents the precepts upon which a comprehensive safety program should be based and gives an outline of administrative procedures for shore installations. In chapter 2, sections 1 and 2 deal with conditions of housekeeping and industrial hygiene for ground, shop, and office safety. The third section of chapter 2 deals with general precautions necessary in warehouse storage and materials handling. Precautions intended for the storage and handling of specified materials connected with particular

operations are included with other specific precautions in subsequent chapters. The titles of chapters 3 through 25 point out their functional or occupational application.

4. Bureau Cognizance. Navy personnel will note that *United States Navy Safety Precautions* cuts across the lines of Bureau cognizance set up by *U. S. Navy Regulations* and applies equally to all activities. When necessary in local and emergency situations, instructions or notices from bureaus, offices, or the officer in command may be issued to supplement and augment these precautions, but not to cancel them.

5. Conflicting Regulations. If precautions and instructions promulgated by the various Bureaus and Offices of the Navy are found to be in conflict with this publication, notice of such variance should be sent through the chain of command to the Office of the Chief of Naval Operations, with copies to appropriate bureaus, offices, and type commanders. Until the conflict has been resolved and any necessary official change has been issued, it shall be at the discretion of the commanding officer to determine, on a common-sense basis, the measures which will achieve maximum safety.

6. Supplementary Information. It is recognized that the forces afloat will not have in their possession some of the supplementary publications referred to in this volume. In such cases, official Navy publications which are applicable and available shall be consulted for further details. In instances where needed information cannot be found, a direct request for it should be made through administrative channels.

7. Excerpts. Excerpts from this publication may be used for posting, for inclusion in the written safety rules of the individual installations, or for training purposes. Such quotations must be kept in context so that the intended meaning of the original text is not distorted.

8. Classified Data. Because of the unrestricted distribution of this publication, no mention is made of classified information, equipment, or materials.

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Since these safety precautions are designed to cover usual conditions in naval activities, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

1. Commanding Officer. The commanding officer shall require that personnel under his jurisdiction be instructed and drilled in applicable safety precautions; he shall require that adequate warning signs be posted in dangerous areas; and he shall satisfy himself that such precautions are being observed.

a. DELEGATION OF AUTHORITY. While the commanding officer cannot delegate the responsibility for the safety of personnel under his jurisdiction, he may delegate his authority to the executive officer and other subordinates to ensure that all prescribed precautions are understood and strictly enforced.

b. SUPPLEMENTAL PRECAUTIONS. In any circumstances where safety precautions appear to be needed but have not been provided, or where existing safety precautions are judged to be inadequate, the commanding officer shall issue new precautions or supplement prevailing ones in the manner and degree that he deems necessary for the protection of personnel. He shall report the omission to the Chief of Naval Operations through the chain of command so that corrections may be made to this volume.

2. Supervisory Personnel. It is the responsibility of supervisory personnel to see that safety precautions are strictly observed in their own work areas. They shall be under orders from, and responsible to, the commanding officer.

3. Operating Personnel. Each individual concerned shall strictly observe all safety precautions applicable to his work or duty.

a. REPORTING UNSAFE CONDITIONS. Each individual concerned shall report any unsafe condition, or any equipment or material which he considers to be unsafe.

b. WARNING OTHERS. Each individual concerned shall warn others whom he believes to be endangered by known hazards or by failure to observe safety precautions.

c. PERSONAL PROTECTIVE EQUIPMENT. Each individual concerned shall wear or use protective clothing or equipment of the type ap-

proved for the safe performance of his work or duty.

d. REPORT OF INJURY OR ILL HEALTH. All personnel shall report to their supervisors any injury or evidence of impaired health occurring in the course of work or duty.

e. EMERGENCY CONDITIONS. In the event of an unforeseen hazardous occurrence each individual concerned is expected to exercise such reasonable caution as is appropriate to the situation.

Section 2

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Department Heads and Supervisors, 01203
Safety Committees, 01204

01201 ORGANIZATION

Each shore activity shall establish a safety organization in order to develop, organize, and direct a comprehensive accident prevention program that provides for the integration and application of safety precautions and safety engineering techniques in all operations.

01202 THE SAFETY OFFICER

1. Definition. The term safety officer or safety engineer as used herein means the head of the safety department, division, branch, or section, whichever is applicable.

2. Authority. The shore safety program shall be under the supervision of the safety superintendent or safety engineer or under the person designated as safety officer by the commanding officer. The safety engineer or safety officer shall be vested with the authority to take immediate steps to stop any operation or hazardous practice where there is impending danger of serious injury, death, or serious damage to equipment or material. Report of such action shall be made immediately to the department head or supervisor concerned and to the commanding officer.

3. Duties. The safety officer (superintendent or engineer) is responsible for advising and assisting the commanding officer in the administration of an effective accident prevention program. The duties of the safety officer or engineer are as follows:

a. SAFETY PROGRAM. He shall act in an advisory capacity to department heads and supervisors. He shall represent the commanding officer at management conferences and meetings on matters of accident prevention. He

shall prepare and submit for approval, policies and procedures and correlate them with the minimum safety and health standards of the Navy.

b. CONSTRUCTION, MACHINERY, AND PROCESSES. He shall consult with the public works officer on safety matters pertaining to plans for public works, new construction, and alterations, and with the plant engineer for procurement and installation of machinery.

c. EVALUATION OF SAFETY. He shall conduct job analyses, review new projects, and make inspections to determine and correct unsafe work practices and unsafe conditions *before they cause accidents*. He shall correlate safety work with that of the industrial hygienist and medical officer in the control of occupational health hazards. He shall see that such equipment as boilers, elevators, weight-lifting equipment, railroad rolling stock, and x-ray equipment is inspected on a regular schedule by a fully qualified person.

d. PERSONAL PROTECTIVE EQUIPMENT. He shall exercise control of specifications for the procurement of protective clothing, safety equipment and devices, guards, etc., and instruct personnel in their application and use.

e. ASSIGNMENT OF PERSONNEL. He shall cooperate with the medical officer, personnel officer, and department heads to assure proper selection and placement of employees from the safety standpoint.

f. TRAINING PROGRAM. He shall cooperate with the training officer in presenting a course in accident prevention or, in the absence of a training officer, set up a safety training program.

g. **MOTOR VEHICLE PROGRAM.** He shall organize a complete program for motor-vehicle accident prevention and motor-vehicle operator education. He shall assist and maintain liaison with other officers charged with portions of the over-all motor vehicle program.

h. **SAFETY EDUCATION MATERIAL.** He shall provide adequate bulletin boards, obtain posters, safety publications, and other educational materials such as films, books, and visual aids. He shall furnish supervisors with suitable technical material to be used in shop safety meetings, and shall maintain an adequate industrial and motor vehicle safety library.

i. **PROMOTION OF INTEREST.** He shall initiate and encourage activities that will stimulate and maintain interest in safety, such as slogan contests, and news releases.

j. **POSTING.** He shall cooperate with the operating departments of the activity in the selection and placement of conspicuous warning signs at danger points.

k. **REPORTS AND INVESTIGATIONS**

(1) *Investigations.* He shall verify supervisors' reports of accidents and whenever necessary, conduct additional investigations to determine causes.

(2) *Reports.* He shall maintain records of accidents in accordance with procedures prescribed in NCPI 190; he shall review all reports of accidents, prepare summaries and analyses, and forward them to the Commanding Officer and other key personnel.

(3) *Corrective Action.* He shall review corrective action proposed by supervisors and wherever necessary, make additional recommendations to eliminate safety hazards. He shall determine that the recommended corrective measures are put into effect.

01203 DEPARTMENT HEADS AND SUPERVISORS

Supervisory personnel are responsible for the following duties:

1. They shall enforce safety regulations.
2. They shall instruct and drill employees in safe practices and shall provide and enforce the use of personal protective equipment.

3. They shall carry out recommendations submitted by proper authority for the correction of unsafe conditions and work methods and shall caution operating personnel regarding hazards beyond their control.
4. They shall conduct regularly scheduled safety inspections within their departments.
5. They shall investigate and analyze the capabilities of employees to see that they are assigned to jobs within their physical and psychological capacities.
6. They shall ensure proper completion and submission of accident and compensation reports in accordance with Navy Civilian Personnel Instructions 90 and 190, and forward them to the safety officer.
7. They shall analyze accidents within their jurisdiction and apply or recommend corrective action to prevent recurrence.
8. They shall hold department safety meetings.
9. They shall seek advice and assistance from the safety engineer or safety officer in their administration of the accident prevention program.

01204 SAFETY COMMITTEES

Safety committees are vital to the success of an accident prevention program. Where feasible, the following general procedures are suggested.

1. **General Safety Policy Committee.** A committee consisting of the commanding officer, medical officer, department heads, safety officer or safety engineer, and other appropriate personnel should be formed to correlate and implement the safety program.

2. **Department Safety Committee.** Department safety committees or shop committees of working personnel should be appointed by the department head or supervisor to provide an opportunity for free discussion of accident problems and to establish ways and means for the prevention of accidents. The membership of these committees should be rotated 50 percent each quarter.

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United States Navy
SAFETY PRECAUTIONS

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HOUSEKEEPING AND HYGIENE;
MATERIALS HANDLING AND STORAGE

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Section I

GENERAL HOUSEKEEPING

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02101 SAFETY ON THE GROUNDS

Care of grounds is in the hands of trained maintenance men, and detailed precautions are not necessary in this space. However, all personnel should be aware of the following precautions, and indications of hazardous conditions should be reported to the person in charge.

1. Outdoor Area Fire Hazards

a. CARE OF LAWNS. Dry weeds and grass shall not be permitted around buildings and railroad properties. Grass should be cut frequently and weeds cut or destroyed by weed-killer compounds.

b. CONSTRUCTION AREAS. All construction areas and storage yards shall be burned over or otherwise cleared before lumber or other combustible material is delivered on the site. A clear space of 50 feet around the outer boundary of storage yards is desirable.

c. COMBUSTIBLE MATERIALS. Areas beneath or within 50 feet of buildings shall not be used for storage of combustible material and shall be regularly policed to keep them free from accumulation of debris and combustible vegetation.

d. FLAMMABLE LIQUIDS. Flammable liquids shall not be poured into sewers or drains or on the ground. They shall be collected in steel drums, cans, or other designated receptacles and disposed of as prescribed by local command.

2. Personnel Safety in Outdoor Areas

a. TRIPPING HAZARDS. Personnel should not leave equipment of any kind on the ground in walking areas even for a short period of time, since this causes a serious tripping hazard.

b. ICE AND SNOW SLIPPING HAZARDS. The best method of meeting ice and snow slipping hazards is to remove the snow or slush before it forms into ice. Where this is not practicable, slipperiness can be reduced by spreading gritty material, such as sand, gravel, or fine cinders over the slippery surfaces. These materials are usually treated with a substance such as calcium chloride or sodium chloride to anchor them in the ice and prevent their being swept off by winds and traffic.

c. PRECAUTIONS IN WATER. No attempt has been made in this publication to deal with the subject of first aid, including drowning, because proper methods depend on the circumstances and on the personnel involved. However, when the nature of the activity requires working in or over water the following safety devices should be provided:

(1) *Life Rings.* Life rings should be placed at intervals of not more than 200 feet at docks and piers where the depth of water is a hazard and the nature of the activity warrants such precaution.

(2) *Life Belts.* Life belts should be provided for men working over water.

02102 CARE OF BUILDINGS

1. Maintaining Order. Working spaces, new construction, and repair areas shall be regu-

larly policed to maintain order and cleanliness, and to reduce fire hazards.

2. Warning Signs. It is inevitable that a building will have transitory hazards such as floor openings or protrusions; also vehicles will have overhanging materials and equipment. When such hazards are present, warning signs (such as flags of arresting colors, traffic markers, or barricades) with adequate lighting shall be provided.

3. Rubbish Disposal

a. SCRAP. Rubbish and scrap materials shall be disposed of in properly identified cans, receptacles, or bins. All rubbish shall be cleared from buildings daily and work areas shall be maintained free from accumulations of combustible debris.

b. FLAMMABLES. Oily rags, steel wool, waste paper, and other flammable materials shall be kept in tightly closed metal containers, and their contents shall be disposed of at the end of the work day.

c. ASHES. Ashes shall be deposited in non-combustible containers. The containers must have covers and must be located at least 2 feet from combustible walls, partitions, or stored material.

4. Walkways and Aisles

a. FREE OF OBSTRUCTIONS. Ample, well-defined space for aisles shall be provided in buildings and in offices and shall be kept free from all obstruction, including such devices as extension cords.

b. BLIND CORNERS. Collision hazards at blind corners can usually be eliminated by the installation of a mirror set at the proper angle.

c. FLOOR ELEVATIONS. Differences of floor elevations in aisles should be indicated clearly. When necessary, handrails should be erected.

d. RUNNING. There shall be no running in buildings at any time because of slipping, tripping, and collision hazards.

5. Decks and Floors

a. WET OR WAXED FLOORS. Wet or highly polished linoleum-covered floors may present slipping hazards. To minimize this danger, floors shall be kept dry during working hours. When wax is applied it should be applied and buffed properly.

b. GREASE. Grease, oils, or other materials

which tend to make decks or floors slippery shall be cleaned up promptly. Absorbing compounds (but not sawdust) may be used to eliminate the slippery condition.

c. FLOOR COVERINGS. Rugs shall be laid smoothly, and loose or torn floor covering shall be promptly repaired, replaced, or removed.

d. HOSE AND CABLE. Welding areas shall be adequately shielded. Hose from oxyacetylene cylinders, steam lines, air lines, electric welding leads, electric cables, and extension cords shall be kept off decks and floors by means of trees, hooks, or troughs.

e. CLEANING LIQUIDS. Gasoline, naphtha, thinners, or any other highly flammable liquids shall not be used to clean decks or floors.

f. TRIPPING HAZARDS. Floors and decks shall be kept free from protruding nails, splinters, holes, and loose boards.

6. Stairs

a. TREADS. Stair treads, unless made of wood, should have antislip surfaces.

b. HANDRAILS. Stairways over 88 inches wide shall be provided with an auxiliary handrail in the center, and a handrail on each side. Stairways over 44 inches but less than 88 inches wide shall have railings on each side. Stairways between 22 and 44 inches should have at least one hand rail.

c. HEIGHT OF RAILS. Stairway openings shall be guarded by railings not less than 36 inches nor more than 42 inches from floor surface to top of railing. Stairway railings shall be not less than 30 inches nor more than 34 inches from the top of the railing to the surface of the tread at the face of the riser. Intermediate railings or suitable screening shall be provided from the top of the railing down to the floor or treads.

d. LIGHT AND CARE. Stairs should be well lighted. Stairs should be kept clean, dry, and free of slippery substances, refuse, or stored material.

e. USE OF STAIRS. Where practical, the duties of employees should be planned so that they will require as little use of the stairs as possible. Employees should be instructed to *walk*, not run on the stairs and to use the handrail.

7. Doors

a. **OPENING DOORS.** Haste in opening doors and entering doorways shall be prohibited, since it is impossible in most cases to determine whether another person is opposite the door or whether obstructions may be present.

b. **GLASS PANELS.** Clear glass vision panels of average eye height are desirable in solid doors.

c. **DOOR STOPS.** Door stops of the loose type shall be put in a safe place when not in use so as to prevent their becoming a tripping hazard.

d. **SPRING TENSION.** Springs on self-closing doors shall be kept at the proper tension so that doors will not close too rapidly.

e. **REVOLVING DOORS.** One person at a time, and only one, shall enter a section of a revolving door.

f. **VAULT DOORS.** Care shall be taken when closing safe and vault doors.

g. **HARDWARE.** Door hardware shall be kept in a good state of repair.

02103 ELECTRICAL INSTALLATIONS

Electrical hazards and precautions in specific situations are discussed in the various chapters of *Safety Precautions*. A general discussion of electricity and electronics will be found in chapter 18. The few precautions given here are general and apply in most situations.

1. Care of Equipment and Outlets

a. **NEW INSTALLATIONS.** All electrical installations should be made in compliance with the rules and regulations contained in the National Electrical Code. Electric light pull chains and keyed metal sockets shall be of the insulated type.

b. **GROUNDING.** Frames or housing of office machines and appliances shall be grounded.

c. **DEFECTIVE EQUIPMENT.** Defective electric cords, lighting fixtures, appliances, and switches shall be repaired or removed. Loose outlet plates may result in short circuits and cause shock through contact with them. They shall be reported and repaired.

d. **SUPERVISION.** There shall be no unauthorized or improperly supervised electrical connections or repairs made in a building.

e. **STUMBLING HAZARDS.** Protruding power or telephone outlets shall be so located as to obviate stumbling hazards. Extension cords shall be fastened at high levels when it is necessary to use them. They shall never be installed across office floors, aisles, or any walking levels.

2. **Disposal of Fluorescent Lamp Tubes.** Although the United States Public Health Service has announced that all manufacturers discontinued the use of beryllium in fluorescent lamps on June 30, 1949, sizable lamp stocks of the old type still exist. These constitute a possible hazard because of the fact that inflammation may result from a broken tube if the powdered beryllium from the interior surface of the lamp enters the lungs or gets into a wound or cut from the glass. It is desirable, therefore, that all discarded fluorescent lamps be broken in order to avoid this health hazard. The following precautions shall be taken in disposal:

a. **PROHIBITED METHODS.** Do not discard fluorescent lamps by placing them with rubbish or refuse where they can be carelessly handled or broken.

b. **BREAKING LAMPS.** In small quantities, fluorescent lamps can be broken individually in their original cardboard jackets by a crowbar or length of pipe. The operator should stand to windward and wear full protection goggles and heavy canvas gloves.

c. **BREAKING IN BURLAP.** As an alternate method, the used tubes can be placed in a weighted burlap bag and immersed in water in a trough or shallow tank, where they can be broken with a crowbar or length of pipe. The wet bag, unopened, must then be removed and dumped.

d. **BREAKING IN METAL DRUM.** Large-scale disposal may be accomplished by use of an open-end metal drum which contains two parallel bars, over which the tubes are broken. The water level of the drum must be *above* these bars. The drum also contains a wire mesh basket, fitted within it, for catching the broken glass. Other similar devices for large-scale disposal may be used provided the device provides for confinement of the material of the tube, wetting of the material, and disposal of the material and water in an approved place.

02104 TOOLS AND EQUIPMENT

Almost invariably tools and equipment are designed for specific uses, and safety in such cases is prescribed in detail in the appropriate chapters. See chapter 16, for precautions concerning commonly used small tools and portable power tools. In general, however, the following two precautions always apply:

1. Tools shall not be left on floors, decks, platforms, scaffolds, stairs, ladders, ledges, rafters, or the moving parts of machines.
2. Lockers, cribs, bins, or storerooms shall be provided for the proper storage of tools and equipment.

02105 ELEVATOR SAFETY

1. Inspections. Inspection of elevators shall be made quarterly for passenger and semi-annually for freight elevators. Freight and passenger elevators shall be weight-tested annually by a competent employee, and notice of such inspection showing date and signature of the inspector shall be conspicuously posted in the elevator car. Each elevator inspector will familiarize himself with American Standards Practice for the Inspection of Elevators, ASA A17.2-1945, and govern his inspection accordingly. Elevators that become defective shall be plainly tagged to that effect and shall not be used until repaired and tested. All elevators ashore shall be installed in accordance with American Standard Safety Code for Elevators, ASA 17.1, 1937 and ASA 17.3, 1942.

2. Carrying Capacity. In each elevator there shall be placed a card or plate indicating its safe carrying capacity. The safe capacity for passenger elevators shall be expressed in terms of the maximum number of passengers to be carried and for freight elevators in terms of the number of pounds. The rated capacity shall never be exceeded.

3. Training of Operators. Only trained persons shall be permitted to operate elevators. Operators shall become familiar with the elevator's emergency devices, understand their functions, and know how to operate them.

4. Passenger Precautions

a. ENTERING OR LEAVING ELEVATOR. Passengers shall guard against tripping when enter-

ing or leaving an elevator. No one shall get on or off an elevator while it is in motion.

b. AUTHORIZED USE. Passengers shall not use freight elevators unless they are authorized for passenger use. Cars not authorized for passenger use shall carry signs to that effect.

c. SELF-SERVICE ELEVATORS. Persons using self-service elevators shall check to be sure the car is in proper position before entering.

5. Operating Precautions

a. COMPLETE ATTENTION. Operators shall not converse with passengers except for business purposes and shall not eat or read while on duty.

b. KEEPING CLEAR. Operators shall never reach into, or place any part of their bodies within the shaftway. When manipulating the car's controls, they shall be inside the elevator *facing the door*.

c. DOORS AND GATES CLOSED. Shaftway doors or gates shall always be closed and locked before the car is started. Car gates shall be kept closed while the car is running. Where no gates are provided, passengers shall be kept away from the open edge of the platform. The car shall always be brought to a complete stop at the landing level before the shaftway door or gate is opened.

d. OPENING AND CLOSING DOORS. When the elevator doors are motor-operated or are of the self-closing type, operators shall always extend an arm across the door opening as the doors start to open or close. Operators should keep their hands away from motor-operated doors. When doors or gates are manually operated, they should grasp only the handles provided.

6. Suspension of Service. Operators shall never leave the operating mechanism unprotected. When going off duty or when service is suspended for any reason during the ordinary operating hours, an "ELEVATOR NOT WORKING" sign shall be displayed at each landing.

7. Operating Failures

a. DIFFICULTY IN STARTING AND STOPPING. If the car will not start it may be overloaded. Operator shall remove load, and if the operating device still fails to work he shall notify the person in charge. If the car refuses to stop, the operator shall not attempt to jump off.

Safety devices and automatic terminal stops will take care of an emergency.

b. UNEXPECTED STOPS. If the car should stop suddenly between floors, the operator shall call the person in charge and operate the machine only at his direction.

8. Repairs, Adjustments, and Cleaning

a. OUT-OF-ORDER SIGNS AND BARRICADES. Prior to beginning repairs, adjustments, or inspections, the car or cars involved should be placed out of service. Doors shall be locked, where possible, and "Out of Service" signs posted at each door. Where doors must be left open, suitable barricades shall be erected.

b. ELECTRIC SWITCH. The service switch of an electric elevator shall always be opened and operating mechanisms locked before any part of the elevator or its operating device is cleaned or oiled. When service is resumed, the operating mechanisms must be in the stop position before the service switch is closed.

c. ASSISTANTS REQUIRED. Work shall not be carried out by only one person if movement of cars by control from the pit or penthouse is involved. Assistants shall be posted to report movement of cars, to warn persons away from openings, make adjustments, and perform other duties as required.

d. WORK IN PIT. The car should be securely blocked before any person goes under it, and it should never be moved while anyone is in the pit or on top of the car except as the person in charge may direct.

9. Loading the Freight Elevator

a. ROPE-OPERATED TYPE. The handrope on a rope-operated elevator shall always be locked before allowing freight to be loaded or unloaded.

b. HOISTING LOAD. Elevator operators shall always see that the locking device and safe-hoisting attachments are in place before a safe or any other heavy concentrated load is moved on or off the car platform. They shall not attempt to raise the car more than a few inches until the locking device has been withdrawn.

c. CAPACITY LOAD. Safes or any other heavy object of a weight close to the capacity of the elevator shall be loaded in the center of the car and operators shall exercise extreme caution in

handling such loads. Only the operator shall be allowed on the elevator during such operations.

02106 OFFICE SAFETY

1. General

a. CEILING FIXTURES. Fixtures attached to ceilings shall be kept securely fastened. Personnel shall at no time work directly underneath fixtures which are being replaced or repaired.

b. PENCILS AND PENS. Sharp-pointed pencils or uncapped fountain pens shall not be carried in belts or placed upright in the handkerchief pockets of coats.

c. SCISSORS. Care shall be taken to see that sharp-pointed scissors are kept in a secure position at all times. If dropped they can penetrate the foot.

2. Filing Cabinets. Overbalancing from various causes is the primary hazard in connection with the use of filing cabinets. The following precautions against overbalancing and other hazards should be taken:

a. SECURING TO FLOOR OR WALL. Individual upright filing cabinets should be secured to prevent overbalancing. Where there are two or more they should be fastened to each other. When steel filing cabinets are aligned in rows, back to back, it has been found that a 1½-inch angle-iron fastened on the floor in front of each row will not only keep the cabinets in line but will prevent them from falling forward when drawers are extended.

b. ALIGNMENT. Cabinets with projecting locking devices should not be aligned with cabinets lacking such devices. Such an arrangement increases the possibility of a worker's striking a projecting corner or locking lever, and serious injury can result. The same hazard exists when cabinets of unequal size are aligned. Cabinets of the same size and style should be aligned.

c. OPEN DRAWERS. Never leave a file drawer open when it is not being used. Do not have more than one drawer of a file open at one time, since cabinets easily overbalance.

d. MATERIAL ON TOP. Do not place heavy material or files of smaller size (such as card-index files) on the tops of file cabinets.

e. SHARP EDGES. Sharp burrs on metal filing cabinet edges cause injury to hands and other parts of the body as well as damage to clothing. Burrs should be eliminated before cabinets are used.

3. Desks

a. SPLINTERS. Splinters and loose veneer on desks should be covered or sandpapered before the desk is used.

b. CREEPING. It is advisable to equip desks and other pieces of furniture with rubber feet to prevent "creeping." This is especially true when desks are placed in close proximity, since in such cases employees often injure their fingers or hands in attempting to realign desks.

c. TYPEWRITER DESKS. The handle should always be used when closing disappearing typewriter compartments. Because of the weight of the typewriter this section of the desk closes rather rapidly and may cause injury to fingers or hands.

d. SHARP OBJECTS. Points of pencils, pens, and other sharp objects should always be laid on the desk with the point away from the person sitting at the desk. When possible, containers should be provided in which to keep sharp objects when not in use. Razor blades should have the cutting edge covered when kept in a desk drawer.

e. GLASS TOPS. Broken glass tops should be disposed of promptly and the desk should not be used until the broken top has been removed. Glass tops should not be used unless absolutely necessary because the reflected light causes eyestrain.

f. PROTRUDING EQUIPMENT. Pencil sharpeners and other equipment should not protrude from tops of desks or other furniture.

g. OPEN DRAWERS. Desk drawers should never be left open, since a person can inadvertently strike or stumble over them and suffer serious injury.

h. NONSAFETY MATCHES. Matches of a non-safety type should not be left in desk drawers.

4. Chairs

a. SWIVEL CHAIR SPRINGS. Weak spring-tension adjusting bolts on swivel chairs may break and throw the occupant with considerable force. Bolts should be checked regularly.

b. TILTED POSITION. Personnel should not sit in a tilted position in any chair.

5. Typewriters

1. Check typewriter well mechanism on desks regularly to see that connections are secure.
2. Do not have lighted cigarettes or matches in the vicinity when cleaning the typewriter.
3. Do not at any time place typewriters on sliding shelves of desks.

6. Miscellaneous Office Machines

1. Before using office machines, be sure they are properly located and not in danger of falling.
2. Never clean or lubricate electrical appliances when they are in operation. When cleaning electrical appliances which are controlled by a switch on the machine, be sure the switch is turned off and the plug pulled.
3. Do not touch any electrical connection with wet hands. Be sure that all electrical equipment is grounded.
4. Protection should be provided against moving parts on addressograph, mimeograph, bookkeeping, tabulating machines, and other types of power-driven office equipment.
5. When office machines are equipped by the manufacturer with 3-wire (grounded) electrical circuits, ground wires must be connected prior to placing machines in operation.

7. Fans

1. Each ventilating fan within 7 feet of the floor or on working platforms which are exposed to contact, should be completely covered with wire mesh of not less than 20-gage, the openings of which will reject a ball one-half inch in diameter.
2. Fans should be checked regularly to be sure there are no loose blades or defective guards.
3. Small electric fans should not be placed on boxes or low tables, or in any other position where an individual might catch hands or clothes in the revolving blades.

8. Baskets

1. Personnel shall not put broken glass in wastebaskets. If a tumbler or other piece

of glassware has been broken, it is suggested that this material be packed in heavy paper, marked "broken glass," and placed alongside the wastebasket at the end of the day so that the person removing waste paper will not be cut accidentally.

2. Distorted metal baskets should be repaired or replaced promptly, since sharp edges and points can cause injury and damage to clothing.
3. Wire or metal mail baskets also become distorted or damaged and have exposed sharp points which present a hazard to personnel. These shall be repaired immediately.

9. Ladders

1. Small ladders and stands used in some offices shall be equipped with treads of non-slip material and safety feet.
2. Rolling and trolley-type ladders shall be provided with braking attachments.

02107 PRINCIPLES OF FIRE

Since fire is one of the greatest and most frequent hazards met in almost any area, fire safety has been given special importance in this publication and is treated in detail in the various chapters. However, for a full understanding of the hazards, and the safety methods necessary, it is desirable that personnel have a knowledge of the principles behind fire prevention and fire fighting. The following paragraphs explain the classification of fires and the treatment of them on the basis of removing at least one of the factors necessary for combustion.

1. Classification of Fires

a. CLASS A. Class A fires are those involving wood, rubbish, etc.

b. CLASS B. Class B fires are those involving oil or oil soaked materials.

c. CLASS C. Class C fires are those involving electrical equipment.

2. Cause of Combustion. Three factors are necessary for combustion, (1) fuel in the form of vapor; (2) oxygen; and (3) sufficient heat to raise a combustible material to its ignition temperature. All three of these factors must be present in the same place at the same time in

order to have fire. When anything burns, it is not the actual substance which is consumed by the flame, but the vapor of the substance in combination with the oxygen of the air. A piece of wood held in a flame will not catch fire until it has been heated to a point where vapor is given off. Therefore, highly volatile products, such as gasoline, which vaporize at ordinary temperatures and pressures, present a most serious fire hazard.

3. Spontaneous Ignition. If large masses of certain combustible materials which have been soaked in oil are allowed to stand, and the heat generated by the slow oxidation process is not allowed to escape, the temperature of the mass rises. If this heating is allowed to proceed, the material reaches its ignition temperature and starts to burn.

For this reason paint-soaked rags and oily waste must be stored in a way least likely to accelerate oxidation and most likely to cause any heat of oxidation to be absorbed by the surroundings. Use only self-closing metal receptacles for discarding oily waste and dispose of such collections daily.

4. Principles of Extinguishing Fires. In order to extinguish a fire one of the three factors necessary for combustion must be eliminated. This may be done by any one of the following methods:

a. STARVING. If the fuel is removed, the fire is extinguished by starving.

b. SMOTHERING. If combustion-supporting oxygen is removed, the fire is extinguished by smothering. The use of foam, carbon dioxide, steam, and sometimes sand, is based on this principle.

c. COOLING. If heat is removed from a fire, the fire is extinguished by cooling. In ordinary fires this is usually done by the application of water. In oil fires, however, water is not used alone because of the fact that a jet of water disperses the oil and spreads the fire. In an oil fire a water fog nozzle should be used. Water fog will extinguish the fire by combination of cooling and smothering. *Water should not, however, be used in an area containing electrical equipment, since water is a conductor of electricity.* Dry powder or carbon dioxide extinguishing agents should be used.

02108 FIRE-EXTINGUISHING METHODS

The subject of fire extinguishers is a highly specialized one, and new methods are being developed constantly. The following paragraphs are meant to give only a summary acquaintance with the principal methods used:

1. Foam Extinguishers. Foam extinguishers are used primarily for oil and gasoline fires. Foam is lighter than the lightest oil products and will float on the surface of the liquid, forming a flexible blanket which cuts off oxygen from the burning oil and extinguishes the flame. The cooling effect of water in the foam also helps to lower the temperature.

a. MECHANICALLY PRODUCED FOAM. Foam may be produced mechanically by the use of air, water, and protein solutions. Foam systems have recently been installed in United States aircraft carriers. Instantaneous operation of these systems is possible through reliable push-button control which puts the entire apparatus in motion in about 12 seconds. A new foam-generating and pumping unit has also been developed for use on land.

b. CHEMICALLY PRODUCED FOAM. Foam may be produced chemically directly from a small extinguisher. A 2½-gallon extinguisher will produce from 20 to 22 gallons of foam. In chemical foam extinguishers an outer chamber

contains bicarbonate of soda and a foam-stabilizing agent dissolved in water; an inner chamber contains a water solution of aluminum sulfate. When the extinguisher is inverted the chemicals mix, creating carbon-dioxide gas which permeates the liquid and forms a tough, durable foam.

2. Carbon-dioxide Extinguishers. Carbon-dioxide extinguishers are used effectively on oil and electrical fires. The liquid carbon dioxide upon contact with air turns into a gas which blankets the fire by shutting off the supply of oxygen.

3. Dry Chemical Extinguishers. Dry chemical extinguishers have been in general use in the Navy only since World War II. They contain chemically processed bicarbonate of soda which is released when a turn of the hand wheel punctures an inner cartridge of carbon dioxide and nitrogen. The chemical releases smothering gas on the fire, and at the same time releases a cloud of dry chemical which shields the operator from the heat.

4. Carbon Tetrachloride Prohibited. Carbon tetrachloride is no longer used by Navy installations for fighting fire, because of the fact that it is extremely toxic. When heated, phosgene, a deadly gas, is liberated and even a small amount may be lethal.

Section 2

GENERAL HYGIENE

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02201 IMPORTANCE

The well-being of workers is maintained by the application of environmental controls and by work habits which eliminate or minimize occupational hazards. Such things as lighting, ventilation, humidity, and cleanliness throughout working areas must be maintained at proper levels at all times in order to assure the best possible health as well as high efficiency levels for workers. Safe and healthful working conditions must be maintained in all naval activities and the following general precautions shall be observed.

02202 INDIVIDUAL RESPONSIBILITY

1. **Physical Examinations.** Both military and civilian personnel who are subject to exposures hazardous to health shall be given periodic physical examinations, as prescribed in NCPI 88.

2. **Injury or Illness.** Injured or sick personnel, no matter how minor the injury or illness may appear, shall report immediately to the proper supervisor and proceed to the dispensary.

3. **Cooperation.** Although the primary responsibility for many factors of health safety lies with specially trained persons who are hired for the purpose, all personnel shall be alert to the necessity for constant awareness and practice of precautions and shall cooperate

with supervisors and other workers for the maintenance of high health and safety standards.

4. **First Aid.** At every activity there shall be someone trained in first-aid methods. Detailed procedures for administering first aid will be found in the *Bureau of Medicine Hospital Corps Handbook* and in the *Red Cross First Aid Textbook*, published by Blakiston & Co.

02203 VENTILATION

1. **Mechanical Ventilation.** If the window areas of an installation do not supply adequate air change, a well-designed mechanical ventilating system based upon the occupancy of the room should be provided and properly maintained.

2. **Control of Contaminants.** Whenever materials, substances, or their byproducts which release contaminants are being processed, adequate preventive measures shall be taken to eliminate these contaminants, either at the point of origin or by local exhaust.

a. **EXHAUST SYSTEM.** Exhaust systems shall be so constructed as to provide air velocities recommended for the capture of dust, fumes, smoke, mist, gases, and vapors at the point of operation. Atmospheric contaminants removed by exhaust systems shall be disposed of in such manner that they do not reenter the breathing zone of workers.

b. **GAS MASKS.** In areas where harmful concentrations of atmospheric contaminants cannot be eliminated, respiratory devices approved by the Navy Department Safety Division shall be provided. Most types for various circumstances are enumerated in *U.S. Navy Manual of Safety Equipment*, NAVEXOS P-422.

3. **Heating.** Precautions shall be taken to prevent extreme and sudden changes in temperature. Heating equipment using carbonaceous fuel shall be vented to the outside.

4. **Humidity.** Humidity in a working area can vary a great deal without noticeable effect on the health or efficiency of personnel. However, relative humidities under 15 or 20 percent act unfavorably on the mucous membranes, and humidities of over 70 percent result in damp condition of the surroundings.

02204 ILLUMINATION

Good lighting not only decreases the hazard of accidents but also enhances the workmen's health and comfort. It also minimizes sight weaknesses and conserves manpower. The various chapters of *Safety Precautions* deal with individual lighting problems and the following general rules shall apply in all naval installations.

1. **Freedom from Glare.** Adequate lighting shall be maintained at all times in working areas and traversed spaces, and such lighting shall be free from glare caused by exposed bulbs or reflected from highly polished surfaces.

2. **Checking Lighting Conditions.** Checks shall be made periodically on the amount of light, the presence of shadow, and spotty lighting. Provision shall be made for an adequate number of globes and reflectors to prevent glare, and for lamps of proper voltage, wattage, and type for the area.

3. **Burnt-Out Bulbs.** Burnt-out bulbs shall be replaced promptly.

4. **Cleaning.** Globes and reflectors do not give the proper light when dust and soot are allowed to accumulate. Globes, reflectors, and walls shall be kept clean at all times. Where painted areas are too dark to allow proper reflection, the walls shall be painted in light shades.

5. **Minimum Levels.** The following minimum levels of lighting shall be furnished, and values greater than these may well be used:

Location	Minimum foot-candles
Roadways and thoroughfares	2
Storage spaces, aisles, stairways, exits, and passageways	5
Spaces such as locker rooms, washrooms, and passageways containing exposed moving machines, hot pipes, or live electric parts	10
Where discrimination of detail is not essential (work such as handling material of a coarse nature, grinding clay products, rough sorting, coal and ash handling, foundry charging) ...	10
Where slight discrimination of detail is essential (work such as rough machining, rough assembling, rough bench work, rough forging, grain milling)	20
Where moderate discrimination of detail is essential (work such as machining, assembly work, bench work, fine core making in foundries)	30
Where close discrimination of detail is essential (work such as fine assembly, leather and rubber fabrication, or sewing light-colored silk or woolen textiles, office work, accounting, typewriting)	50
Where discrimination of minute detail is essential (work such as fine lathe work, tool making, drafting, weaving or sewing dark-colored material, very fine inspection or inspection of very dark goods)	100

It must be understood that circumstances may prevent installing lighting systems that provide the above foot-candles of illumination. Before attempting to improve lighting conditions the safety engineer and public works officer should be thoroughly satisfied that improvements are necessary for health, safety, and efficiency.

02205 INSECT CONTROL

The measures used in the control of insect pests require special precautions. Chapter 36 of the *Bureau of Ships Manual* or *Manual of Preventive Medicine and BuMed Instructions* of the 6250 series may be used as a supplementary reference for the following precautions:

1. **Insecticides.** Use of standard stock catalog materials such as Navy insecticides, aerosols, DDT compounds, powders, and solutions, is recommended as the most effective means of controlling insects.

a. **USE OF DDT.** Cockroaches, water beetles, ants, lice, fleas, and silverfish may best be attacked by application to runways and hiding places of nonexplosive DDT emulsion (not xylene-DDT emulsion) or water-dispersible DDT powder, preferable in 10 percent strength. A 5 percent concentration shall be used for eradicating bed bugs.

b. **GENERAL INFESTATION.** Where insect infestation warrants, storerooms should be emptied, cleaned thoroughly, and sprayed with either of the above-mentioned applications.

c. **MOSQUITOES.** Mosquitoes in holds and compartments should be sprayed with aerosol bombs. Mosquito larvae should be destroyed by emptying water containers and spraying with DDT the potential breeding sites which cannot be emptied.

2. **Fumigants.** Fumigation solely for the control of insects shall be undertaken only for the eradication of moths, weevils, or beetles in dry food stores where other means of control are not practicable. Infested dry foodstuffs aboard ship should be returned to shore-based supply depots for fumigation by specialists if facilities are available and if it appears economically feasible to do so. Foodstuffs beyond salvage shall be surveyed in accordance with Navy Regulations or *Bureau of Supplies and Accounts Manual*.

02206 RODENT CONTROL

1. **Hydrocyanic Acid Gas Fumigation.** Hydrocyanic acid gas is extremely toxic and fumigation must be conducted by the United States Public Health Service.

2. **Carboxide Gas Fumigation.** Carboxide gas is the only fumigant authorized for use on shipboard by naval personnel. It may be used when, in the opinion of the commanding officer, deratization is urgently required, and the rodent population may not reasonably be exterminated by trapping or poisoning, and the facilities of the United States Public Health Service are not available for hydrocyanic gas fumigation. When using carboxide gas, the following precautions must be taken.

a. **REMOVING PERSONNEL.** Personnel in general shall be required to leave the area before

fumigation and shall not be permitted to resume their normal activities in the area until so authorized by the fumigating authority.

b. **GAS MASKS.** Members of the working party detailed to open carboxide cylinders or to help with clearing the area of gas after fumigation shall wear self-contained oxygen rescue breathing apparatus. While the toxic effects of carboxide gas are not great, headache, nausea, and vomiting can result if the proper apparatus is not worn.

c. **ISOLATING AREA.** The ventilating system (supply and exhaust) shall be stopped and sealed. Watertight covers where provided shall be closed to isolate the space being fumigated. Where watertight covers are not provided the dampers of all terminals must be closed and the louvers plugged with damp rags or waste.

d. **SEALING OPENINGS.** Seal all openings which could permit gas escape. Use masking tape or a combination of greased paper and masking tape for magazine vents, voice tubes, radio leads, enunciator chains leads, nonwatertight doors, natural ventilators, etc. Close all drains in heads and bathrooms. Dog down all watertight doors and air ports.

e. **FANS.** Start all bracket fans in the space or spaces to be fumigated.

f. **DANGER FROM HEAT.** Open-flame heaters and exposed-element electric heaters shall not be used in areas being fumigated. In the presence of relatively high temperatures such as may be locally produced by such heaters, the ethylene oxide content of carboxide may break down chemically, lose its fumigating properties, and create a condition of flammability not existent in the original fumigant.

3. Handling Carboxide Cylinders

a. **CONNECTIONS.** Rubber tubing or rubber hose shall never be used with carboxide. Any added connections must be of metal and suitable for working pressures of 800 pounds per square inch.

b. **SECURE POSITION.** Cylinders shall be securely lashed in an upright position before they are used, since the violent discharge of gas tends to unbalance the containers.

c. **GROUNDING.** Cylinders shall be grounded before use so as to avoid static sparks.

d. **OPENING VALVES.** Cylinder valves shall be

tested in advance in order to be certain that there is no resistance to opening by hand. Then the valves of the cylinders shall be opened successively, beginning with the unit farthest from the exit and directing the nozzle or control valve away from the operator.

4. Ventilating Area After Fumigation. The area being fumigated by carboxide gas shall be opened at the end of 3 hours. The length of time required for airing varies according to the status of ventilation. Except in poorly ventilated spaces (see paragraph d following below) it is ordinarily safe for personnel to resume their activities after 2 hours, but the exact period in specific cases must be determined by the person in charge of fumigation in conjunction with the medical officer. The following precautions shall be taken in ventilating the area:

a. OPENING TO OUTSIDE AIR. Personnel wearing self-contained oxygen rescue breathing apparatus shall open all air ports or other connections to the outside air and reestablish exhaust ventilation of the space which was fumigated. Supply ventilation may also be used if necessary.

b. MECHANICAL EXHAUST AND SUPPLY VENTILATION. Where permanent mechanical exhaust ventilation is not provided, portable ventilating fans should be used for exhausting the space. In such a case the mechanical supply ventilation should *not* be operated.

c. DEAD-AIR POCKETS. Particular care shall be taken to clear spaces containing dead-air pockets where the odor of carboxide tends to persist.

d. POORLY VENTILATED SPACES. Personnel shall not enter storerooms or other poorly ventilated spaces until the day following fumigation.

02207 WASH AND LOCKER ROOMS

1. Location. Washrooms and locker rooms are separated in most buildings. In the few cases where they are combined as one room, the lockers should be far enough removed from showers and lavatories so that water cannot be splashed near the lockers or on equipment or clothing kept there. Washrooms are usually

located near the entrances of buildings so that workmen may change clothing when going to and from work. However, the number of employees and the type of work done determines the location. There must be adequate facilities in each installation, based on the number of employees.

2. Specifications for Washrooms. Aside from the obvious fact that clean and pleasant washrooms add greatly to the morale of personnel, proper washing facilities are often necessary for the prevention of occupational diseases. Skin disorders account for a large number of occupational diseases and their spread can be stopped only by proper facilities in washrooms and proper habits on the part of personnel.

a. LIGHTING

1. Sufficient window area should be supplied to give adequate light in washrooms.
2. Light fixtures should be so installed that they cast sufficient light in all parts of the room, and the fixtures should be mounted near the ceiling out of reach of workmen.
3. Switches should be so located that persons cannot operate them while in contact with a grounded conductor, such as any part of a water system. Switches should not be located in shower room or where personnel may touch them while bodies are wet.

b. VENTILATION. If the window area does not supply sufficient ventilation for the area, forced ventilation should be provided to give six to ten air changes an hour.

c. HEATING. Washrooms and locker rooms should be kept at a comfortable temperature. The following precautions shall be taken in heating the rooms:

1. Pipes, radiators, or other appliances shall be so installed as to allow ample space for cleaning.
2. Heating appliances shall be protected to preclude the possibility of workers being burned.
3. Salamanders, stoves, or gas heaters must be vented to the outside air, and they shall not be used unless so vented.
4. Open-flame heaters shall not be permitted.

d. FLOORS, WALLS, AND CEILINGS

(1) *Nonabsorbent materials.* The floor, and the walls to a height of at least 6 inches, should be of a nonabsorbent material such as terrazzo, quarry tile, ceramic tile, or concrete. The walls should be of material impervious to water to a height of at least 5 feet and full height in shower rooms. Walls should form a tight joint at the floor level, or the floor and wall should be continuous to a height of 6 inches.

(2) *Nonslip Surface Floors.* Slipping and falling when floors are wet is a primary hazard in washrooms. A terrazzo floor composed of 40 to 60 percent carborundum or other abrasive is satisfactory.

(3) *Worn Flooring.* Leaky floors can cause rotting of joints and other supporting members and may attract vermin. Worn wood floors should be repaired and overlaid with ceramic tile. Worn concrete floors shall be covered with new concrete topping.

(4) *Color.* Walls, ceilings, and partitions should be light in color to give a clean appearance, to increase illumination, and to facilitate cleaning.

e. FIXTURES

(1) *Lavatories.* The number of lavatories installed is dependent on the number of employees (See *Bureau of Yards and Docks Design Criteria*, No. 8, *Plumbing Designs for Buildings*). However, where employees are exposed to skin contamination with poisonous, infectious, or irritating material, one lavatory should be installed for every five employees. The desirability of using industrial type wash fountains should be investigated in such situations. Personnel shall always wash in a flowing stream of water and shall not use a stopper in the lavatory. Drainage of water after a stopper is used leaves dirt in the basin and may transmit disease. Cloth towels, including roller towels, shall not be allowed for common use.

(2) *Faucets.* Both hot and cold water should be provided at each fixture, preferably with one outlet so that they may be mixed and the desired temperature maintained.

(3) *Hot Water Heaters.* Heaters for supplying hot water should not be located in

washrooms or locker rooms if any other arrangement is possible. If it is necessary to have heaters in the room, care should be taken to prevent the accumulation of unburned gas and carbon monoxide. Flues should be installed to exhaust the gases directly to the outside air.

f. SOAP

(1) *Acidity and Alkalinity.* Liquid or powdered soap dispensed in convenient containers is preferable for use in washrooms, since the concentration of acidity and alkalinity in such soaps can be predetermined. This is of vital importance where employees are exposed to dermatitis hazards. Mineral abrasives, wood-abrasive soap, and high-alkali soap are considered harmful and shall not be used.

(2) *Bar Soap.* The use of a common bar soap shall not be permitted.

(3) *Industrial Soap.* Soap used for industrial purposes shall not be used for the hands since such soaps, particularly scouring powders, contain a large amount of sodium carbonate.

(4) *Sand or Pumice in Soap.* Soaps containing sand or pumice shall not be used, since these contents are apt to settle in traps and clog the plumbing fixtures.

(5) *Chemicals and Solvents.* Solvents or chemicals shall not be used as hand cleaning agents to remove dyes, paint, or other stains. These cleansing agents are potentially harmful, since they are either primary skin irritants or are sensitizing allergenic or drying substances.

3. *Showers.* Wherever personnel may be exposed to excessive heat, moisture, dusts, or toxic vapors and liquids, the installation of shower baths is highly recommended. *Showers shall always be installed where workers are exposed to poisonous dusts.* The following precautions shall be observed in the installation and use of showers:

a. *STALLS.* Each shower should be enclosed in a stall to prevent splashing of other workmen.

b. *FLOORS.* Floors and approaches to showers should be on nonslip material such as concrete with an abrasive surface or ceramic tile.

c. *WATER SUPPLY.* Each shower shall be

provided with hot and cold water faucets so that users may regulate the temperature of the water. A regulating valve, or valves should be placed on a side wall where it may be easily reached from outside the stall.

d. PIPES. Supply lines to the shower baths should be so placed as to avoid the possibility of persons coming in contact with the hot pipes.

e. MATS. Two mats of material specified by medical authorities must be provided so that one set can be sterilized and aired in the sun while the other is in use.

f. PREVENTING SPREAD OF RINGWORM. Shower bath equipment should be thoroughly scrubbed daily and a disinfectant or germicidal agent used to prevent athlete's foot infection and ringworm. The following agents are effective:

1. a 1- or 2-percent solution of sodium hypochlorite;
2. a 10-percent solution of sodium thiosulphate;
3. a 10- to 20-percent solution of sodium chloride (common table salt). The solutions should be put in rubber pans and placed so that personnel can step into them when going in and out of showers.

4. Toilet Rooms. Requirements for the construction of floors, walls, and ceilings and for lighting, ventilation, and heating in toilet rooms are the same as those given above for washrooms (see 2. preceding).

a. PERSONAL PROTECTION

1. Persons suffering from any communicable disease which may be spread by a common use of toilets shall be barred from the installation until the period of contagion is past.
2. Expecterating on floors and wall shall not be tolerated. Cuspidors should be provided where necessary.
3. Covered receptacles with self-closing lids and made of fire-resisting material should be provided in all personal service rooms, especially those used by women.
4. Eating lunches in toilet rooms is prohibited.

b. CHEMICAL CLOSETS AND PRIVIES. Chemical closets and privies should not be installed

except temporarily during construction operations. Disinfectants shall be used as needed.

5. Lockers. All employees working with lead compounds or other poisonous or toxic materials should be provided with two lockers—one for street clothes, lunch, etc., and the other for work clothes. Where two lockers are used it is preferable to have the showers and washrooms between the locker for work clothes and the locker for street clothes.

a. LOCKS. Preferably the lock should be a combination or keyless one, so workers will not have to carry keys.

b. OVERTURNING. Lockers should be fastened in position to prevent overturning.

c. VENTILATION. Lockers should have good ventilation and should be at least 4 inches off the floor. An exhaust system to suck air through slots in the lockers to the outside of the building is recommended.

d. TOPS CLEAR OF DEBRIS. Storage of old clothes and miscellaneous materials on top of lockers is prohibited.

e. OIL-SOAKED CLOTHING. Workmen should not be permitted to keep oil-soaked or badly soiled clothes in lockers, as this practice may cause a serious fire.

6. Cleaning Wash and Locker Rooms. Floor washing should be done when the washroom is not in use. If this is not possible, only a small portion of the floor should be done at one time. Floor drains are not required in wash and locker rooms. Soapy water must not be allowed to remain on the floor at any time.

a. SOAP AND WATER. Hot water and soap are highly efficient as cleansing agents and should be used on the floors and fixtures daily.

b. DISINFECTANTS. If a disinfectant is used, it shall be of a germicidal type and shall be added directly to the wash water. *It should be used in addition to, and not in place of, soap and water.*

c. SALT WATER. Where salt water is used in closets and urinals or where the water supply is likely to contain grit, a strainer should be connected to the supply line to prevent grit or dirt from reaching the valves. Provision should be made for cleaning these screens at regular intervals.

d. CUSPIDORS. If cuspidors are used, they

should be cleaned at least daily. Where possible, use the disposable type of cuspidor.

e. NEATNESS. Personnel shall never put used paper towels in toilet stools or throw soap or wet towels on the floor or on equipment, but shall always dispose of them in the proper receptacle.

f. INSPECTION

1. Washrooms should be inspected daily.
2. Toilet rooms should be inspected at least twice daily.
3. The right should be reserved to inspect lockers and require that they be kept clean.
4. Bacteriological examination of the water supply should be made at least each week, the frequency depending upon the source of supply, and a chemical examination should be made every 6 months. (Where city water is used, the city health department usually assumes responsibility for the examination.)

Section 3

MATERIALS HANDLING AND STORAGE

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Subsection A

MATERIALS HANDLING

02301 ACCIDENT CAUSES

1. **Kinds.** The largest percentage of accidents suffered by employees in the Naval Establishment occur during materials handling operations. Mechanical handling causes fewer accidents but in most cases, they are of greater severity. Hand methods cause more accidents but generally of a minor nature. However, careful space planning, proper selection of equipment, and adequate training of employees will reduce the number of injuries due to handling of materials.

2. **References.** Only broad over-all precautions that will lessen the chance of injury will be included in this section. Precautions for the handling and storage of individual materials will be found under the appropriate headings in later chapters of this publication. For instance, the loading of trucks and railroad cars will be found under Land Transportation, chapter 4, and stevedoring and the handling of fork trucks on shipboard, under seamanship, chapter 5. Detailed procedures for storage may be found in various Bureau of Supplies and Accounts publications and in the BuSandA Manual, volume II.

02302 PERSONAL PROTECTION

1. **Shoes.** All personnel engaged in materials handling operations should wear approved safety shoes. Sandals and all types of open-toe shoes or shoes with thin soles shall *not* be worn.

2. **Leg Guards.** Foot guards and leg guards should be worn by employees working with or handling very heavy objects.

3. **Gloves.** Gloves shall be worn by all employees carrying, lifting or moving sharp or bulky objects that have sharp edges or projecting points. Unless other factors interfere all laborers should wear gloves.

4. **Handling Acids.** When handling acids, caustics, or strong solvents, personnel shall wear suitable approved gloves, rubber aprons, acid-resistant boots, and goggles or face shields.

5. **Cleanliness of Equipment.** All personal protective equipment shall be issued clean and should be cleaned frequently if necessary.

6. **Belts.** When working on high elevations, a life line and safety belt shall be worn unless other adequate precautions have been taken to prevent falling.

7. **Rings.** Finger rings should not be worn by personnel handling stores.

8. **Physical Defects.** Personnel with existing hernias, or who have a history of previous back strains shall not be assigned to duty requiring heavy lifting.

02303 HAND HANDLING

1. **Lifting.** All personnel engaged in handling materials of any type should be instructed by their supervisors in, and shall carefully follow, the proper method of lifting heavy objects. The lifter stands close to the load, with feet solidly placed and slightly apart. With knees bent, he shall grasp the ob-

ject firmly, and then lift by straightening the legs, keeping the back as nearly vertical as possible.

2. Lowering Material. Material shall never be thrown from elevated places to the floor or ground. Suitable lowering equipment shall always be used.

3. Signals. Lifting or lowering operations being performed by several persons shall be done on signal from one individual and only after everyone's feet, hands, etc., are in the clear.

4. Hand Trucks. Hand trucks and similar devices shall not be so heavily loaded that they cannot be easily handled. When going up or down a ramp or incline, the load shall always be below the worker. Thus he will pull the load up and push it down.

5. Drums. Drums should be rolled by pushing with the hands. Gloves shall be worn when performing this operation.

6. Sharp Edges. Before any material is handled, it shall be examined and personnel shall be protected against sharp edges, protruding points, or other factors likely to cause injury.

7. Straps on Cargo. Defective or broken strapping on cargo shall be removed, repaired or replaced. When removing steel strapping, face shields or goggles shall be worn and the

worker and those in the immediate area should stand to one side and out of the line the strapping will pass when cut.

02304 MECHANICAL HANDLING

1. Standard Equipment. Standard equipment shall be used for the handling of materials within naval activities. It shall be kept in good condition and personnel shall be thoroughly trained in its use and in attendant safety precautions.

2. Mechanical Alterations. Materials handling equipment is engineered and guaranteed by the manufacturers to perform specified functions. Mechanical alterations to power plants, hydraulic systems, operating levers and controls, lifting and structural members, counterweights, etc., may not be made without the approval of the Bureau of Supplies and Accounts. Requests or recommendations to effect alterations will be addressed to the Bureau of Supplies and Accounts (Storage Division) and will include the following:

1. Complete details of the proposed alteration including such photographs, blueprints, and engineering data as may be necessary;
2. Reasons for the alteration and improvement expected to result therefrom.

Subsection B

WAREHOUSE STORAGE

02321 FLOOR CAPACITIES

1. Permissible Weight. Whether a warehouse is of single or multistory construction, floor load limits must be observed. Floor capacity is commonly stated in pounds per square foot. Usually the floor capacity gives the maximum allowable average weight over each area bounded by four supporting columns or over an entire section, and is not a positive indicator of the maximum weight which may be stacked at any one point. In some cases, however, it is to be regarded as the maximum weight at any one point on the floor. If the exact meaning of the floor capacity as stated is not known, the public works department

should be consulted. The load exerted on the floor by a stack of materials is determined by dividing the total weight of the stack by the square foot area it covers on the floor. Such calculations are simplified by regarding the area of the standard pallet as 16 square feet, or 13.5 square feet if a 40- by 48-inch standard pallet is used.

2. Volume of Combustibles. Permissible floor loading is also rated on the basis of volume of combustible material. In some cases, therefore, the weight limitation may not be the governing factor. See *Bureau of Yards and Docks Technical Publication TP-PU-4, Fire Prevention and Fire Protection*.

02322 STACKING MATERIALS

1. Palletized Materials. All palletized materials shall be so placed and secured as not to present a hazard in stacking when in transit, inside warehouses, between warehouses, in storage, and between warehouses and piers, loading docks, and platforms.

2. Arrangement. All material shall be stacked in an orderly manner so as not to present a hazard to personnel or likelihood of damage to material or equipment.

3. Crushable Containers. Crushable containers should have vertical supports placed in such a manner that weight of material stored above will not be supported by the containers.

4. Corner Markings. Suitable protectors made from either metal, wood, or cardboard shall be placed at corners of material at aisle intersections to prevent damage to material and containers. Such protectors shall be painted brilliant yellow high-lighted by black diagonal striping.

02323 WORKING AISLES

1. Definition. Working aisles are those from which material is placed into and removed from storage. They are of two types: transportation aisles, running the length of the building, and cross aisles, running across the building. Determination of the number, width, and location of working aisles is a problem of major importance. Aisles determine bay boundaries and, therefore, limit the space actually used for storage.

2. Direction. Aisles should lead directly to doors whenever practicable. With mechanical operation, turning corners slows movement. The greatest number of accidents involving equipment occurs at corners or aisle intersections. When placement of a direct aisle results in considerable loss of space or is otherwise inefficient, the storage officer must weigh the loss of space against slower operation and increased hazards.

3. Widths Required for Trucks. The required aisle widths for using the common sizes of fork trucks are:

- 2,000 pound truck, 10 feet
- 4,000 pound truck, 12 feet
- 6,000 pound truck, 14 feet

These are not the minimum aisles in which the trucks can operate. They are considered the minimum for reasonably fast operation and for two-way traffic. All widths stated are figured on the basis of a 48-inch load length. They must be increased slightly if tractors and trailers are used within buildings in conjunction with fork trucks, in order to provide space for the removal of pallet loads from trailers.

02324 FIRE PREVENTION

1. Accessibility of Fire-Fighting Equipment. Whenever possible, portable fire-fighting equipment should be placed along operating aisles for easy accessibility. When fire-fighting devices, including water valves and hose outlets, cannot be so placed, a 36-inch fire aisle must give access to them. Such equipment must never be obstructed. Fire aisles should in all cases lead to the nearest working aisle. Instructions of the safety engineer and local fire authorities must be followed.

2. Clearance of Stacks

a. OVERHEAD. Below automatic sprinkler deflectors the clearance shall be:

1. stack heights not exceeding 15 feet—18-inch clearance;
2. stack heights exceeding 15 feet—36-inch clearance;
3. where hazardous commodities are involved, regardless of stack heights—36-inch clearance.

b. WALLS. Between stacks and walls, except as otherwise required for materials subject to excessive swelling, the clearance shall be:

1. exterior walls and standard fire walls—no clear space will be required;
2. substandard fire walls (less than a four-hour rating)—24-inch clearance;
3. when hazardous materials are stored in general purpose building, clearance shall be 24 inches.

3. Fire Doors. Around path of travel of fire doors, there shall be a 24-inch clearance unless a barricade is provided in which case no clearance shall be required. Material will not be stored within 36 inches of fire wall openings.

4. Storage of Flammables. Flammable materials, such as paints, oils, grease, gases, and gasoline, are best protected when placed in a special nonflammable building with extra fire-fighting equipment and additional firewalls. Because of lack of such space, however, it may be necessary to store flammables in a general storage warehouse. In this case, precautions should be taken to:

1. use end bays whenever possible;

2. handle containers carefully to avoid breakage;
3. remove and destroy leaky containers;
4. maintain accessibility to stack interior for fire-fighting purposes;
5. insure proper ventilation for materials which give off flammable vapors;
6. avoid any location where spilled liquids may come in contact with spark or flame;
7. use only spark-enclosed fork trucks.

Subsection C

MATERIALS HANDLING VEHICLES

02341 GENERAL REQUIREMENTS

1. Licensed Operators. Fork-lift trucks, straddle trucks or industrial tractors shall be operated only by duly authorized operators who are specially licensed for each particular type of vehicle.

2. Passengers. Industrial vehicular equipment shall never be used for personal transportation. No workman other than the driver shall ride on any industrial materials handling vehicle unless a permanent seat is provided.

3. Loads. The operator is responsible for all cargo being moved by his machine. He shall inspect and secure all questionable loads and shall refuse to transport unsafe or unlawful loads.

4. Steering Wheel Projections. No fork truck or other materials handling equipment shall be equipped with a steering knob or extension to gear-shifting levers.

5. Clear Vision. All materials handling equipment will be free of cabs, windshields, enclosures, canopies, and any other device which may constitute a safety hazard by obstruction of vision. Side curtains may be placed on straddle trucks provided they do not extend above the top of the cowl and are made of transparent material with only sufficient opaque material to permit fastening. When equipment has an overhead safety guard in accordance with instructions herein, it will be free of any material that may obstruct vision in any direction.

6. Adjusting Mechanism. Operators shall not attempt to fix or adjust any mechanical part of any materials handling vehicle unless authorized to do so by their supervisor.

7. Gasoline-Powered Vehicles. Gasoline-powered and gas-electric-powered materials handling equipment will be equipped with flame arresters, gas fill caps, and metal sediment bowls. Fuel shall be dispensed from Underwriters Laboratory approved containers. All fueling operations shall be done out of doors.

8. Vehicle Unattended. Operators shall never leave vehicle unattended while the motor is running.

9. Speed Limit and Care at Exits. Fork trucks and tractor-trailer trains shall not exceed the speed limit of 7 miles per hour. They shall slow down at all cross aisles and other passageways. When entering or leaving buildings, warehouses, etc., the operator shall come to a complete stop at entrance, sound horn, and proceed only when the way is clear. These vehicles shall be operated in a safe and prudent manner at all times.

02342 FORK TRUCKS

1. Overhead Safety Guards. Fork-lift trucks of all types will be equipped with an overhead safety guard fabricated from steel. Exceptions will be permitted only when the overhead safety guard would either increase the overall height of the fork truck or prevent the operator from having freedom of movement. Overhead

guards will be capable of withstanding, without evidence of damage, a minimum drop of 5 feet of a wood box or container of 1 cubic foot of volume, weighing 100 pounds. Open spaces between steel bars or tubes will not exceed 6 inches.

2. Load Capacity. The load capacity, and gross weight of each fork truck, shall be stenciled on the machine in plain view of the operator. This capacity shall never be exceeded. Counterweighting of machine to increase lifting capacity is prohibited. Capacity shall be rated at 24 inches from heel of forks.

3. Standing Under Loads. No personnel shall ever stand under loads being hoisted or lowered by fork trucks.

4. Facing Forward. Operators shall always face in the direction of travel. All loads shall be carried in such a manner that operator's vision is unobstructed in direction of travel.

5. Ramps and Grades. Fork trucks transporting cargo up ramps or other grades shall be operated with the load up grade; carrying cargo down grade shall be done by backing down grade with the load up grade.

6. Channels Tipped. All loads being transported shall be carried with channels tipped back.

7. Hoisting Personnel. Fork trucks shall be used to hoist personnel only under the following conditions:

1. Supervisor shall authorize all raising and lowering of personnel by fork trucks.
2. Special "personnel pallets" with guard rails on four sides shall be used.
3. During actual raising and lowering operation, all personnel shall face away from mast and keep hands clear of hoisting mechanism.
4. Personnel shall never be transported in an elevated position.
5. Only skilled personnel shall be asked to perform tasks requiring elevation by fork trucks.

8. Lifting Vehicles. Slings or lifting pads shall never be attached to the overhead guards for the purpose of lifting the vehicle.

9. Nonoperating Position. When not in operation, the forks shall be lowered and rested flat on the floor.

10. Bumping Stacks. Stacks shall never be bumped or pushed by fork trucks in an attempt to straighten stacks.

11. Spacing. In all operations involving more than one fork truck, vehicles shall always remain 20 feet apart unless two vehicles are transporting the same object.

02343 STRADDLE TRUCKS (GANTRY TRUCKS)

1. Inspection. Before commencing daily operations, each straddle truck driver shall thoroughly check vehicle in accordance with standard procedures. All approved guards and safety devices shall be in proper repair and in operation at all times.

2. Blocking up Cargo. All cargo carried by these vehicles shall be blocked up sufficiently to prevent any part of cargo coming in contact with surface over which cargo is being transported.

3. Marking Cargo. Cargo extending beyond lines of straddle truck shall be clearly marked with red danger flags during daylight hours; at night red lights shall be used.

4. Sounding Horn. Straddle trucks operating in the vicinity of personnel shall sound noise-making device.

5. Public Highway Operation. Straddle trucks operating on public streets or highways shall be equipped with all safety devices required by State law.

02344 TRACTOR-TRAILER TRAINS (JITNEYS AND TRAILERS)

1. Traffic Regulations. Tractor operators shall obey all traffic regulations at all times.

2. Trailer Connections. Trailers shall be firmly hitched one to the other and to the tractor before beginning operations. These hitches shall be inspected at least four times daily.

3. Maximum Number of Trailers. No more than eight trailers shall be used per train while transporting material in dock or shop areas.

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United States Navy
SAFETY PRECAUTIONS

Chapter 3
AVIATION

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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AVIATION

Section I

INTRODUCTION

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03101 ASHORE ACTIVITIES

The contents of this chapter cover general situations pertinent to aviation. Commanding officers will amplify these precautions to suit particular activities, promulgating more detailed instructions where necessary.

03102 AFLOAT ACTIVITIES

Individual needs of aviation activities afloat are not fully covered. Precautions given shall be complied with where applicable. Command-

ing officers will issue further instructions according to particular ships and operating schedules.

03103 AMPHIBIOUS ACTIVITIES

Personnel attached to amphibious activities shall be made cognizant of the difference encountered in operating ashore and afloat. Just prior to transferring ashore or afloat, particular emphasis shall be given as regards the new surroundings and anticipated operations.

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03201 INSTRUCTIONS TO PERSONNEL

1. **General.** Personnel shall receive proper instruction and training in safe operations around aircraft and aircraft maintenance installations.

2. **Local Safety Orders and Directives.** Local safety orders and directives pertaining to engine ground operation, taxiing, towing, mooring, beaching, and launching will be promulgated.

03202 FIRE PREVENTION

1. **Signs.** Warning signs shall be displayed in all areas where potential hazards exist from flammable gases.

2. Stowage of Combustible Materials

1. Covered metal containers shall be provided and used for storing supplies of clean rags, waste, and other combustible materials in immediate use.
2. All used waste, rags, and other combustible material shall be deposited in plainly marked covered metal containers.
3. Containers, plainly identified and kept separate from those in 2 above, shall be used for oil and paint-soaked materials.
4. Disposition of these containers shall be made with such frequency and in such a way that they will not become a fire hazard.

3. Smoking

1. No smoking, or open flames will be permitted within 50 feet of parked aircraft, hangars, shops, or other buildings in which highly flammable materials are stored or being used.
2. These "No smoking" areas will be placarded.
3. Special designated smoking rooms or smoking areas may be provided and placarded after due caution is exercised.
4. **Grounds.** Grounds, particularly around buildings, shall be kept free of fire hazards, such as trash and dried vegetation.
5. **Fire Lanes.** Suitable fire lanes for passage of fire-fighting equipment will be designated, marked, and kept clear.

03203 GROUND HAZARDS OF AIRCRAFT ENGINES

1. General

1. Suitable placards and appropriate guards or deflectors shall be provided to prevent accidents with propellers, intake ducts of jet engines, and exhaust ducts of jet and rocket engines.
2. Due precautions shall be taken to prevent damage to equipment, or injury to personnel by slipstream, jet blast, or rocket blast.

3. Sufficient time to permit the cooling of jet, ram jet, and rocket engines shall be observed prior to inspection or work on these engines.

4. Protective clothing will be worn when working with contaminated parts (such as inspections inside jet engines).

2. Securing Aircraft. Aircraft engines shall not be started until the aircraft is properly secured with approved chocks, tie downs, or other approved securing means. Chocks will be removed with utmost caution when engines are in operation, and then only upon the proper signal. The approach for removal of chocks will be made from a safe direction, with due regard for the location of propellers and jet intakes and exhausts.

3. Propellers

1. Propellers on reciprocating engines shall not be pulled through on a warm or hot engine as the engine may kick over and start. If the engine does not cease firing immediately when the mixture control is placed in idle cutoff and the switches turned off, do not subsequently touch the propeller until the difficulty has been found and corrected.

2. Due to the low friction in turbo-propeller engines, these propellers will turn freely for a considerable time unless stopped by a braking device. Personnel must be duly instructed in the necessary precautions for servicing this type of engine.

4. Proper Man at Controls. Before starting engines a qualified operator shall be in the pilot's seat.

5. Fire Guard. Prior to the starting of an airplane engine a qualified fire guard shall be stationed strategically near the airplane, to the rear and side of the engine being started. The fire guard will be equipped with approved fire-extinguishing equipment and will be prepared for its immediate use. The fire guard will stand by in readiness until all engines are operating and the danger of fire no longer exists.

6. Signals and Challenges. In starting the aircraft, all challenges and signals between the person operating the starting device or pulling the propeller through and the person at the

engine controls shall be clearly understood and so indicated by repetition before action is taken by either person. Where the engines are started entirely from the cockpit, the person at the engine controls shall exchange signals with a person observing the engine from outside the aircraft.

7. Helicopters. When the engine of a helicopter is started, a qualified helicopter pilot shall be in the pilot's seat except that commanding officers may authorize certain qualified non-pilot helicopter personnel to ground test helicopters provided that the helicopter is securely tied down.

8. Testing Engine. When an engine is started by nonpilot personnel for testing or warm-up purposes, the aircraft shall be tied down in an approved fashion.

9. Propeller or Jet Blast. Before starting an engine for a high power turn-up, the aircraft shall be tied down in an approved manner and placed in such a position that the propeller or jet blast will not cause damage.

03204 TAXIING

1. Taxi Signals. Only approved standard aircraft taxi signals shall be used. Personnel shall be instructed in the use and meaning of these taxi signals. Approved illustrations of these signals shall be posted in appropriate places.

2. Taxi Pilots. No one shall be permitted to taxi an aircraft except such persons as are authorized to fly it, and those who have been specifically designated and authorized by the commanding officer.

3. Taxi Director. Sufficient ground control personnel must be available to provide for the safe taxiing of aircraft in the vicinity of obstructions or other aircraft.

4. Taxiing. All taxiing shall be done at safe authorized speeds and in a manner appropriate to the type of aircraft being taxied, care being taken that the path ahead is clear of other aircraft, equipment, and obstructions.

03205 TOWING

1. Authorization. Personnel shall not move any aircraft with towing equipment without first being duly authorized.

2. Operation of Equipment. Only qualified personnel shall move or operate towing equipment and attachments. It shall be made certain that all is clear and in readiness prior to operation of equipment.

3. Towing Attachment. Towing couplings shall be thoroughly inspected prior to towing. Only approved attachment devices will be used. Attachments shall be made secure to couplings on the airplane provided for this purpose.

4. Towing. Towing will not begin until an authorized and qualified operator is in the cockpit and ready to operate the aircraft brakes when necessary.

5. Towing Speed. Towing speed should never exceed five miles per hour. Sudden starts or stops shall be avoided. Extreme caution shall be exercised when towing an airplane over rough or muddy ground, or into or through a congested area.

6. Wing Walker. When towing an airplane near hangars or obstructions, a wing walker should be stationed at each wing tip to insure adequate clearances. At night the wing walker shall carry a flashlight or luminescent wand.

03206 AIRCRAFT FUELS

1. Characteristics

1. Current Bureau of Aeronautics directives shall be consulted for detailed instructions on specific aircraft fuels. A general discussion of the characteristics and behavior of hydrocarbon fuel is included in chapter 17 of this publication.
2. The ignition of vapor from aircraft fuel may occur from static sparks, sparks from tools, hot exhaust pipes, lighted cigarettes, electrical devices, and similar sources.
3. Aircraft fuel vapor is heavier than air and will settle to the ground, accumulating in dangerous amounts in depressions, troughs, or pits.

2. Health Hazard

1. Aircraft fuel on the skin should be avoided, as dermatitis and poisoning may result.
2. Inhalation of aircraft fuel may cause unconsciousness and illness.

3. The ingestion or swallowing of aircraft fuels will result in internal injury.

3. Fire Precautions

1. Smoking and other possible sources of ignition shall be prohibited where aircraft fuels or other combustible liquids are stored or handled. Warning signs will be posted.
2. All accidental spills of aircraft fuels or other combustible liquids shall be immediately removed, protected by washing, covered with a foam blanket to prevent ignition, or neutralized by other means. The proper fire authorities shall be notified if necessary.
3. If indications of underground leakage of combustible liquids are discovered, areas shall be guarded by appropriate means, and the proper fire authorities notified immediately.
4. Aircraft fuel tanks shall be filled, purged, or have an inert gas (such as CO_2) over the gas in the tanks before storing airplanes in hangars, since this leaves no space for explosive vapors to form.
5. Nonspark tools shall be used when working on any part of a system or unit designed for storing or handling combustible liquids.
6. Use of leaky tanks or fuel lines shall not be permitted. Repairs shall be made on discovery, with due regard to the hazards involved.

03207 FUELING FROM TRUCKS

In fueling, the same hazards exist and the same safeguards must be taken at airfields in forward areas as those taken at well run airfields under normal operating conditions. The procedures described herein are, therefore, to be followed at all times except as changed, under abnormal conditions, by the commanding officer.

1. Crew and Truck

1. Only authorized and qualified personnel will be permitted to operate fuel equipment.
2. Fuel truck crews shall be carefully indoctrinated in the safe procedure to be

observed in fueling an airplane from a tank truck.

3. Whenever possible, fuel truck crews should consist of a minimum of two men.
4. Fuel trucks having leaky or otherwise defective pumping equipment shall not be used, and shall be so placarded.
5. During the fueling process, smoking, striking matches, or the use of any device producing flame within 50 feet of the aircraft or truck is strictly prohibited.

2. Position of Airplane. When an airplane is to be fueled by truck, it should be located on the apron or a dispersal site and should not be in the vicinity of possible sources of ignition such as blasting, drilling, or welding operations. When practicable, a minimum of 50 feet from other airplanes or structures should be maintained, and of 75 feet from any operating radar set. Consideration will be given to the direction of the wind so that fuel vapors will not be carried toward a source of ignition.

3. Position of Truck. The tank truck should be driven to a point as distant from the airplane as the length of hose permits, and preferably to the windward (upwind) side of the plane. It must be parked parallel to or heading away from the wing, in such a position that it may be driven away quickly in the event of fire. As soon as the fueling operation has been completed the truck should be removed from the plane's vicinity. Truck manway covers should be kept closed except when a tank is actually being loaded, or when pumping fuel at 25° F. (-3.9° C.) or below, as at such temperatures vent valves may be inoperative. The driver must always stay with his truck while fueling is in process.

4. Fueling Procedure

a. GROUNDING. Prior to fueling, grounding devices on planes and the drag chains on trucks shall be inspected to ensure that both plane and truck are properly grounded.

b. BONDING CABLE. The bonding cable attachment to the tank truck shall be inspected, and the other end of the cable shall then be attached to a bare metal part of the wing of the plane, using the fixture provided for this purpose.

c. ELECTRICAL HAZARD. The chief of the ground crew shall check with the plane chief, or

other authorized representative of the plane crew, to ensure that no electrical equipment is energized or being worked on, and that no electrical apparatus supply by outside power (electrical cords, droplights, floodlights, etc.) is in or near the plane. For night refueling, flashlights instead of aircraft lights shall be used.

d. STATIC DIFFERENTIAL. After unreeling the fuel hose and before using it, the hose nozzle must be brought in contact with some metal part of the plane remote from the fuel tanks to make doubly sure that no differential in static exists.

e. ATTACHING WIRE CLAMP. Before removing the tank filler caps, the hose nozzle independent static wire clamp must be attached to a metal part of the wing at a safe distance from the filler openings and the tank vents. In some installations, spring sockets are provided for receiving the ends of grounding cables fitted with plugs.

f. FIRE EXTINGUISHER AND ATTENDANT. A second operator must stand by on the wing or ladder while the clamp is being attached and during the filling operation. He will be provided with CO₂ hand extinguisher, and a second extinguisher should be readily available.

g. FILLER CAPS. The filler cap of but one fuel tank at a time will be removed. It must be replaced immediately after that tank is filled and before removing the cap of any other tank. Exception to this rule may be made if dual fueling equipment with a full complement of trained personnel is available.

h. TANKS OF STORED PLANES TO BE FULL. Fuel tanks of planes will normally be filled before the planes are placed inside a hangar or any closed storage. Full tanks, with provision for expansion of the product, are considered less of an explosive hazard than tanks that are partially empty.

i. ON COMPLETION OF FUELING. After filling all the tanks of the plane, the steps outlined above will be reversed, the "apron" ground wire, if used, being disconnected as the last operation.

03208 FUELING FROM STATIONARY PITS

The procedure for fueling from stationary pits is virtually identical to that described for fueling from a truck. However, before starting to fuel, the chief of the ground crew must see to it that the plane is electrically grounded by

the attachment of the pit grounding cable to the plane so that both pit and plane will be at the same potential.

03209 FUELING FROM BARRELS, DRUMS, OR CANS

1. **Additional Hazards Involved.** In outlying locations, planes may be fueled directly from drums, barrels, or cans by emptying the contents of the containers, through chamois filters, into the tanks of the plane. This introduces additional hazards, including an increased vapor release. A second potential ignition hazard may result from failure to properly bond the filter to the fill hose and the plane. Fueling through funnel filters can be accomplished only with difficulty during heavy rains, and is a most difficult operation to perform safely in the dark.

2. **Maintaining Contact Between Containers.** During any transfer of gasoline from cans to drums, intermediate tanks, or trucks, metal-to-metal contact between the containers involved *must* be maintained.

03210 FUELING CABIN TANKS

1. **Ventilation.** The operation of filling gasoline tanks temporarily installed in plane cabins where the filling must be done on the inside of the plane, is more difficult than the filling of wing tanks and introduces hazards of an extreme nature. During this operation, the cabins must have all possible ventilation.

2. **Danger of Asphyxiation.** A second operator provided with an extinguisher, should be prepared to act rapidly in the event of fire, and should watch the first operator for symptoms of asphyxiation.

3. **Significance of Gasoline Odor.** An odor of gasoline within a confined space of a plane is a danger signal calling for immediate investigation. All ignition sources must be eliminated as practicable until such vapors are removed and the condition corrected.

03211 DEFUELING

Defueling will be done outside the hangar and under controlled conditions similar to those required for fueling. If it is absolutely necessary to defuel an airplane within the hangar, the

main doors will be opened and all shop doors leading into the hangar will be closed. No work will be done in the vicinity of an airplane while it is being thus defueled, and all ignition sources will be prohibited. Fire protection devices, attended by trained personnel, will be available.

03212 CHECKS, SERVICING, AND GROUND TESTING

1. **Static Grounding.** Airplanes will be securely and effectively connected to a low-resistance ground before any maintenance services are performed.

2. **Airplane Walkways.** Only approved and designated walkways will be used when it is necessary to walk on airplane surfaces.

3. **Tool Kits.** Care shall be exercised to prevent tool kits or tools from endangering airplane surfaces or being left inside the aircraft.

4. **Solvents.** The use of aircraft fuel as a solvent or for cleaning engine parts is forbidden. All cleaning operations will be performed with approved high flash point or non-flammable safety solvents.

5. **Fueling.** No work of any nature is permitted on an airplane while fueling.

03213 AIRCRAFT CRASH AND RESCUE

1. **Personnel.** Only authorized personnel shall respond to aircraft crash emergencies. Crash crews will use protective clothing designated for use in fighting aircraft fires.

2. **Traffic.** Crash equipment shall be operated only by fully qualified personnel in accordance with NCPI 190. This equipment shall have the right-of-way over other vehicular traffic, but when traveling on station or public roads such equipment shall proceed with caution and observe traffic rules to the extent compatible with the circumstances encountered. Crash vehicles operating in landing area shall, in general, observe ground rules in force for landing and taxiing aircraft.

3. **Spillage of Aircraft Fuels.** When an aircraft crash occasions spillage of aircraft fuels or other combustible liquids that do not result in fire, extreme caution shall be observed by the crash crew to prevent fire. Immediate steps shall be taken to wash away the spillage, cover it with foam, or neutralize it by other means.

4. Ordnance

1. In the event of fire involving a crashed aircraft in which live bombs are carried, all firefighting and rescue operations shall be discontinued and withdrawal to a safe distance made if the fire is not under control within 3½ minutes.
2. Aircraft crash firefighting crews will be thoroughly instructed in fighting fires involving aircraft with live ammunition or ejection seats.
3. Crash crew personnel will be kept informed as to whether or not the aircraft is carrying live ammunition.

5. Fire Drills

1. Crash fire crews will be trained by periodic practice fire drills.
2. Standby fire apparatus shall be manned and ready to operate.
3. Smoking shall be prohibited in the immediate area.
4. All station activities having a crash phone connection shall be notified.
5. Gasoline shall be poured on ground or fuselage from an open container. Drums may be emptied by laying on their side and allowing free flow from bungs. Care shall be taken to prevent sparking when handling drums and opening bungs to release gasoline.
6. Personnel handling gasoline shall be clothed in full firefighting gear.
7. The fire chief or assistant will be in charge at all times.
8. No loitering will be done in a gasoline spill area.
9. Setting fire to gasoline or oil spills shall be done only after: all personnel and fuel containers are clear of the fire area; standby fire apparatus is manned and ready to operate; assurance that no low-flying aircraft will pass in line of smoke or fire.
10. Spill fires shall be ignited by throwing a torch in the spill area or, in the case of large spills, by use of a Very pistol.

03214 DANGER MARKINGS

1. **Airfield.** The following standard markings will be used for dangerous areas on all airfields:

1. Small holes and soft spots on the usable portion of landing fields shall be marked by day with yellow flags or yellow pyramids and by night with red lights to warn incoming pilots that the particular spots so marked are unsafe for landing.
2. When relatively large areas are unsafe for landing they shall be outlined by day with yellow flags and by night with red lights.
3. The fact that the entire area outlined is unusable shall be indicated by placing in its approximate center, by day, a relatively large cross made up of yellow flags or strips of yellow fabric, and at night, red lights.
4. Whenever a well-defined runway is closed, a large cross made of yellow flags or yellow strips of fabric shall be placed at each end of the runway in sufficient numbers to make certain that the cruciform arrangement is clearly distinguishable. The crosses prescribed shall be large enough to warn visiting pilots that the area or runway is unsafe for use. A large number of individual markers shall not be used because they make it impossible for a pilot to determine which area is to be used and which avoided.
2. **Closed Targets.** In order to give more adequate security to personnel engaged in repairing closed targets, the following system of visual signals will be used:
 1. Closed land target—two yellow strips, 3 feet wide and 200 feet long shall be placed in the shape of an X adjacent to the target.
 2. Closed water target—yellow dye shall be placed in the water immediately surrounding the target.
 3. If a pilot fails to recognize the above visual signals and commences his run on a closed target, standard red parachute flares shall be fired by the repair crew as an emergency signal.

03215 ORDNANCE

1. General

1. When conducting operations with or handling ammunition, pyrotechnics, or explo-

sives, the current applicable ordnance pamphlets, and instructions of chapter 20 of this manual shall be consulted and complied with.

2. Areas in which explosives and ammunition are stored, and areas in which operations involving explosive hazards are being conducted, shall be designated as restricted areas and properly placarded and guarded.
 3. Ordnance materials shall be handled only by authorized personnel.
 4. Safety devices provided for ordnance materials shall be used according to instructions.
 5. Ammunition shall be fired only in the device or gun designated for that ammunition.
- 2. Handling**
1. Handling of ammunition and explosives shall be kept to a minimum and shall be conducted with the utmost care at all times.
 2. A red flag (International "Baker") shall be flown whenever explosives are being handled.
 3. **Fire Safety.** All measures for the prevention and control of fires shall be taken in areas containing explosives and in areas immediately adjacent to them.
 4. **Weapons Aboard Aircraft**
 1. When loading, arming, dearming, or making safe ordnance equipment aboard aircraft, the safety precautions for the weapon being loaded, handled, or serviced shall be observed.
 2. Aircraft with loaded guns or live rockets shall be pointed clear of other aircraft, hangars, and personnel insofar as practicable.

03216 MAINTENANCE OF GROUNDS

1. Roads and Walkways. Roads and walkways should be unobstructed and well defined. When required, adequate illumination shall be provided.

2. Construction. Construction hazards on the grounds, such as excavations, shall be clearly

identified by signs and suitable barriers erected around them.

03217 AUTOMOTIVE EQUIPMENT

1. Vehicle Markings. Uniform requirements for the marking of vehicles used on landing areas, taxiways, and aprons will be observed.

a. AMBULANCES. Ambulances used on the airfield will be painted in accordance with the Bureau of Yards and Docks requirements.

b. CRASH RESCUE AND FIREFIGHTING EQUIPMENT. Crash rescue and firefighting equipment used on the airfield shall be painted red.

c. SERVICE, MAINTENANCE, AND CONSTRUCTION EQUIPMENT. Service, maintenance, and construction equipment used regularly on the airfield will be painted chrome yellow. Front and rear bumper plates will be painted in alternate stripes of chrome yellow and black in accordance with applicable regulations.

d. MISCELLANEOUS VEHICLES. All vehicles not regularly used on the airfield should carry a flag 3 feet square attached to a staff and flying above the vehicle whenever operations on the airfield are necessary. The flag will consist of a checkered pattern of international orange and white squares not less than one foot on each side.

2. Authorized Equipment. The amount of automotive equipment authorized on flying fields should be reduced to the absolute minimum.

3. Operating on Airfield

a. PARKED AIRCRAFT. Vehicles should not pass underneath any part of an airplane on the ground. Where such passing is absolutely necessary, the vehicle will come to a complete stop and, before proceeding, a visual check will be made to ensure that sufficient clearance exists.

b. PASSENGERS. Vehicles carrying passengers will stop only at the boarding entrance and well clear of an airplane while loading or unloading passengers.

c. TAXIING AIRCRAFT. No vehicles will stand or drive into the path of a taxiing aircraft except the authorized guide or "follow me" vehicle.

d. AIRCRAFT ENGINE RUN-UP. No vehicle will stand, park, or drive in the danger areas of an aircraft while its engines are in operation.

Section 3

HANGAR AND SHOP SAFETY

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03301 GENERAL

1. **Personnel.** Personnel will be instructed in safe operation of shop and hanger equipment.

2. **Hazardous Areas.** Hazardous areas will be placarded with appropriate warning signs.

3. **Maintenance Operations.** Numerous operations pertaining to maintenance are identical with certain line functions. Appropriate articles of section 2 will be observed.

4. Decks

1. Decks will be maintained smooth and clean, free of all obstructions and slippery substances.

2. Decks will not be cleaned with volatile flammable liquids.

3. When using cleaning agents which may be toxic or noxious, adequate ventilation will be provided to dissipate the vapors.

5. **Working Spaces.** Working spaces will be kept free of all unnecessary obstructions, hangings, and trappings on bulkheads.

6. **Passageways.** Passageways will be clearly defined and kept free of hazardous obstructions. In the storing of materials, clear passageways will be maintained as approach ways for fire fighters and for easy access to fire-fighting equipment, sprinkler control valves, fuse boxes, and switch panels.

7. **Stacking Materials.** Materials will be securely stacked. Caution will be exercised in piling material so that there will be no possibility of tipping. In no event will material be piled higher than 18 inches below sprinkler heads.

8. **Tools and Tool Storage.** Tools will be han-

dled and stored in manner consistent with safe practices. Racks will be provided at locations where tools are frequently used, such as at work benches. Lockers, cribs, bins, or storerooms will be provided for the storage of tools and tools will be kept at these locations when not in use.

9. **Lighting.** All machines, work benches, passageways, ladders, and rooms will be adequately lighted.

10. Vending Machines

1. Suitable containers will be provided for waste from vending machines.

2. Electrically operated vending machines will be grounded; they will not be located in areas such as dope and paint shops where concentrations of explosive gases and vapors may exist.

11. **Clothing Lockers.** Clothing lockers shall be maintained in a clean and orderly condition and adequately ventilated. Material shall not be stored on top of or underneath lockers. Clothes kept in lockers shall be aired and cleaned regularly. Flammable liquids, chemicals, paints, paint-soaked rags, and similar materials shall not be kept in clothes lockers.

03302 FIRE PREVENTION

1. **Smoking Notices.** An adequate number of approved "No smoking" signs shall be posted in conspicuous places where hazard of fire or explosion exists.

2. **Fuses.** Only fuses of the proper amperage and type shall be used in fuse boxes. Improvised devices shall not be used.

3. Blown Fuse. When a fuse has been blown, the source of the disturbance shall be detected and corrected. Fuse pullers shall be used for the insertion or removal of all fuses.

4. Electrical Equipment. All electrical equipment used in the vicinity of flammable gases and vapors must be of an approved type.

5. Grounding

1. All electrical equipment, metal frames, and other parts associated with electrical equipment must be connected to a low resistance ground.

2. Substantial conductors, having low resistance to ground, will be used to ground all stationary and portable machines, equipment, and other devices in which static charges may be generated in the vicinity of flammable gases and vapors. The contact between conductor and ground will be made only with clean, unpainted metal surfaces and shall be inspected periodically.

6. Tools and Devices. Tools, metal fan blades, door latches, and similar devices used in the vicinity of flammable gases and vapors shall be of nonferrous or nonsparking type. Nonsparking shoes shall be worn when necessary.

7. Aircraft Fuel Trucks. Aircraft fuel trucks, whether loaded or empty, shall neither enter nor be stored in hangars or other buildings not designated for the purpose.

8. Open Flames. Devices employing open flames should not be used in the vicinity of flammable liquids and gases. Continuous fresh air ventilation is to be provided wherever flammable vapors may be encountered.

9. Heating Units. Open flame or element space heaters will not be used in any part of a hangar or in any shop where a fire hazard will be created. In no case shall such heaters be permitted in locations where concentrations of flammable and explosive liquids or gases or similar hazardous substances are present.

10. Paint Spraying. Paint spraying in hangars shall be permitted only when specifically authorized by the commanding officer.

11. Containers

1. Drums or other receptacles containing aircraft fuels, oil, dope, paint, or varnish shall be kept only in locations free of

sparks, flame, or other sources of ignition. These storage areas shall be placarded with warning and "No smoking" signs.

2. Empty flammable liquid containers shall not be stored until they have been thoroughly cleansed of hazardous vapors unless storage is in accordance with the requirements for full containers. The fuel tanks of small gasoline engines shall be similarly cleansed before indoor storage.

12. Ventilation. In buildings where aircraft fuel piping and equipment is utilized, or where flammable volatile liquids are used, stored, or handled, adequate natural or forced ventilation must be provided to prevent dangerous vapor concentrations.

03303 ELECTRICITY AND ELECTRONICS

The precautions in this section shall be considered incomplete in themselves, and personnel working on or near electric and electronic equipment shall be thoroughly familiar with the details given in chapter 18. The following precautions serve to emphasize the more hazardous areas of electrical work.

1. Personnel. Only authorized personnel will be permitted to install and maintain electrical equipment. Personnel working with electrical circuits will avoid wearing loose clothing, rings, watches, and other jewelry.

2. Safety Devices. Switch boards and control panels shall be protected by enclosures or barriers with locking doors. Rubber mats or insulated decks shall be provided at operating locations.

3. Control Switches. Personnel shall be certain that switches are off before plugging in external power. Before a switch is thrown it must be ascertained that personnel are clear of the equipment.

4. High Voltages. When working near high voltage, approved personal protective equipment shall be used. Personnel must exercise caution not to stand on metal, wet decks, or make contact with the frame of the equipment. Be constantly observant of power outlets as to rated capacity and radio frequency.

5. Wiring. Wires carrying AC or DC current must have a circuit breaker or be properly

fused. Exposed uninsulated wiring shall not be used.

6. Soldering Irons

1. Electric soldering irons must not remain connected longer than necessary.
2. Soldering irons must be kept away from flammable material.
3. Hot soldering irons must not be used without proper rest holders.

7. Flammable Fumes. A check for presence of flammable fumes shall be made before activating electrical or electronic circuits, or keying transmitters when in an enclosed area.

8. Electronic Power Supply Circuits. All power supply filter condenser shall be grounded before work is done on electronic equipment. Grounded shorting prods should be permanently attached to work benches where radar equipment is regularly repaired.

9. High Intensity Radar. Care must be taken within a 75-foot radius of high intensity radar to prevent ignition of certain substances such as volatile gases.

03304 BATTERY AND PLATING SHOPS

1. General

1. Only authorized personnel instructed in the hazards and precautions connected with the handling of acids shall be employed in the battery and plating shops.
2. Smoking, open type lights and switches, or flames shall not be allowed in the vicinity of batteries on charge. Appropriate warning signs will be posted.
3. The battery shop must be well ventilated.
4. Approved protective goggles, gloves, boots, and aprons should be worn when handling electrolytes.
5. A deluge shower or source of running water shall be provided in the battery shop. Shower and valve controls will be placarded, and painted to contrast with their background.
6. Approved first-aid materials shall be provided for neutralization of acid spilled on the body. Posters and labels will clearly indicate the specific application of each first aid material.

2. Water and Acid. In mixing water and acid for batteries, always pour the acid into

the water slowly. Never pour water into the acid.

3. Burns and Poisoning. When working around acid, caustic, or other equipment containing corrosive chemicals, every precaution must be taken to avoid personal contact with these chemicals. In case of personal contact with corrosive chemicals or acid apply first aid and get medical attention.

03305 AIRPLANE DOPES AND DOPE ROOM PROCEDURE

1. Nitrate Dope. Nitrate dope and lacquers must be treated and handled as highly volatile substances. When dry and suspended in air as a dust cloud, the particles present a dangerous flash-fire hazard.

2. Ventilation. The ventilation system shall be in operation in the dope shop during all doping operations and in dope storage spaces during storage of dope and solvent in unsealed containers. Shop doors and windows shall be kept closed while doping so as to allow the thermostatic control to function properly. Ventilation control should be marked in yellow and black and placarded "Blower Switch."

3. Health Protection

1. Dope spraying shall not be allowed in a confined area unless required ventilation and humidity conditions are maintained.
2. Personnel shall wear approved personal protective clothing as provided.
3. Personnel employed in doping operations shall wash thoroughly before eating. The carrying of food into, or eating in the spraying compartment is strictly forbidden because of probable contamination.

4. Approved protective ointments shall be used by personnel whose hands come in contact with various solvents.

4. Fire Precautions

1. All work shall be grounded by a flexible cable attached by means of battery clips to the work at one end and to an approved ground connection at the other.
2. No person entering the dope shop shall be allowed to carry on his person matches, lighters, or any material which may cause a spark.

3. Approved nonsparking shoes shall be worn.
4. The use of nonexplosion-proof lights within fifty feet of doping or cleaning with solvents is prohibited.
5. The dope solvents and other flammables in the shop shall not exceed the amount necessary for one working day. Containers in excess of one gallon shall be stowed in approved and placarded areas. Brushes and other containers shall be stored in fire-proof lockers at the end of the working day.
6. Adequate firefighting equipment shall be on hand before doping operations are commenced.
7. Fans, blowers, ducts, and decks shall be cleaned at regular intervals.
8. Dope rooms shall be kept free of all material not required for the immediate operation.
9. The use of steel scrapers for cleaning concrete decks is prohibited.

Section 4

OPERATIVE EQUIPMENT

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03401 ARRESTING GEAR, BARRIERS, AND BARRICADES

1. **Personnel.** Only qualified personnel shall be permitted to operate or maintain arresting gear, barriers, and barricades. Unauthorized personnel shall be kept clear of the walkways and flight deck.

2. General

1. All arresting engine spaces shall be unlocked during operations.
2. Suitable warning placards will be posted in accordance with arresting gear maintenance instructions for the particular gear in use.

03402 CATAPULTS

1. **Operating Instructions.** Catapults should be operated only under the direct supervision of a qualified catapult officer trained for this work.

2. **General Precautions.** Only qualified personnel should be engaged in these operations. They should have a thorough knowledge of catapult equipment, together with its operation and maintenance, and of aircraft launching procedure.

3. **Safety Placards.** Appropriate placards shall be posted covering the cautions and warnings promulgated in the catapult handbook of the particular equipment being used.

03403 JET ASSISTED TAKE-OFFS

1. Housing of JATO Boosters

1. Buildings and compartments housing JATO boosters shall be posted with signs stating the nature of their contents.

2. Doors to work rooms and conditioning rooms shall be capable of easy access from either inside or outside the room.
3. Only authorized personnel shall be permitted in the JATO work and storage rooms.

2. Handling of JATO Boosters

1. Flame proof clothing should be worn by personnel working with boosters.
2. No drilling or welding shall be done on loaded boosters.
3. Boosters shall be handled as pyrotechnic materials.

3. **Accidental Firing.** In case of accidental firing in a work room or a storage room, all personnel shall leave the building immediately. No one should reenter the room until a safe period of time has elapsed.

4. Pre-Flight Precautions

1. A thorough check shall be made of the booster.
2. No electrical appliances shall be used on loaded boosters.
3. Igniter leads shall be shorted at all times during handling and storage.
4. Currents used in making continuity checks shall not exceed 30 milliamperes.
5. The igniter shall not be installed in any JATO booster until the unit is immediately ready for firing or in the firing position unless otherwise specifically authorized.
6. Never connect an igniter lead before making sure that all JATO switches are off and a dead circuit check has been made with circuit tester.
7. Keep personnel and equipment well clear of firing JATO boosters.

03404 GUIDED MISSILES**1. Operation**

1. The operation of guided missiles shall be conducted with due consideration for the potential hazard which they constitute when out of control.
2. Guided missiles shall be operated at such an altitude and distance that endangering personnel and property on the ground is reduced to a minimum.
3. In operating guided missiles, due con-

sideration shall be given to avoiding other aircraft in flight.

2. Flight Planning. In planning and conducting flights to, in, and from operating areas, all activities operating guided missiles shall select and adhere to flight tracks and altitudes which will completely minimize the possibility of missiles falling into a congested area in the event of electronic or material failure.

3. Acrobatics. Acrobatics shall not be performed unless required for operational exercises, test, or evaluation of operational design.

Section 5

INFLIGHT SAFETY OF AIRCRAFT

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03501 PILOTS

1. **Authorization.** Commanding officers shall permit only those persons to pilot aircraft whom they consider competent and qualified to do so.

2. **Responsibility.** A naval aircraft taken into the air shall be commanded by a Naval Aviator, Naval Aviation Pilot, or other person authorized by the Chief of Naval Operations. The pilot in command of the aircraft is responsible for the safe and orderly conduct of the flight. The authority and responsibility of the pilot in command exists from the time he enters the aircraft preparatory to flight until he leaves it upon completion of the flight.

3. **Training.** No flight training in Navy or Marine aircraft shall be given to any individual without the specific authorization of the Chief of Naval Operations, the Chief of Naval Personnel, or the Commandant, United States Marine Corps. This does not prohibit regularly assigned aircrew members from being given sufficient instruction to maintain an aircraft in the air satisfactorily while the pilot is engaged in other duties.

03502 PASSENGERS

1. **Identification.** All passengers shall be identified by appropriate means and their presence aboard the aircraft listed and recorded in the manner prescribed by the Chief of Naval Operations.

2. **Status of Personnel.** All personnel aboard the aircraft will be either in the status of the aircraft's crew or of passengers, and this status shall be definitely understood and recorded prior to the flight.

3. **Safety and Survival Equipment.** Passengers shall be instructed prior to take-off on such passenger safety and survival equipment as is required for that particular aircraft in which they embark.

03503 FIRE HAZARDS

1. **Smoking.** Smoking in aircraft is forbidden under the following conditions:

1. during fueling operations, including transfer and jettisoning;
2. during and immediately after take-off;
3. immediately before and during landing;
4. whenever any gas fumes are detected in the aircraft;
5. during all ground operations;
6. in the bomb bay or the fuselage or hull compartments which contain gasoline tanks;
7. in the cabin when cargo of a flammable or explosive nature is aboard;
8. during inspection of aircraft compartments wherein gas or other flammable fumes may have collected;
9. whenever oxygen equipment is in use.

2. **Fuselage and Hull Tanks.** In aircraft where fuselage or hull tanks are installed smoking shall be permitted in compartments adjacent to the fuel tank compartment(s) only when all doors and ports of such compartment(s) are secured.

3. **Instructions to Passengers.** For aircraft regularly employed in transporting passengers, appropriate orders and regulations shall be promulgated by the responsible commands with due regard for the fire hazards involved in the types of aircraft in use. These orders and

regulations shall be prominently displayed in the aircraft. The orders shall be enforced by the pilot in command of the aircraft. He is empowered to prohibit smoking at any time or in any part of the aircraft when he deems such action necessary.

03504 CHANGE IN CONTROL OF AIRCRAFT

Piloting control of an aircraft will be changed only in the conventional manner prescribed by the Chief of Naval Operations.

03505 AIR TRAFFIC RULES

1. **Civil.** The Civil Aeronautics Board (CAB) is charged under the law with prescribing the air traffic rules governing the flight of aircraft, including safe altitude of flight and the prevention of collision. These rules are promulgated as Civil Air Regulations and are binding on naval personnel in the operation of naval aircraft over United States territory except when appropriate military authority determines that military necessity requires noncompliance.

2. **Military.** In addition to the air traffic rules promulgated by the Civil Aeronautics Board, naval aviators and aviation pilots shall be governed by regulations prescribed by the Chief of Naval Operations for the operation of military aircraft.

03506 AERIAL MANEUVERS

1. **Maneuvers Authorized.** Only maneuvers permitted for the particular aircraft by instructions and orders issued by the Chief of Naval Operations and the Bureau of Aeronautics will be permitted.

2. Acrobatics

1. Acrobatics will be performed only when duly authorized as prescribed by the Chief of Naval Operations.

2. Only personnel with current orders to duty involving flying will be permitted in naval aircraft performing acrobatics.

03507 AEROLOGICAL AND NAVIGATION INFORMATION

1. **Display Boards.** Display boards to indicate

general flying weather conditions will be posted in the manner prescribed by the Chief of Naval Operations.

2. **Maps.** A suitable aeronautical map corrected to show pertinent aeronautical information (such as all air space reservations, danger areas, caution areas, air space warning areas, civil airways, control zones, and such other information as prescribed by competent authority) shall be displayed where it can be readily seen by pilots as they prepare their flight plans.

3. **Other Aids.** Other flight-planning aids will be provided as required by the Chief of Naval Operations or other competent authority.

03508 AIRCRAFT SAFETY INSTRUCTIONS AND PLACARDS

1. **Authorization.** Only those safety placards and markings duly authorized by competent authority with regard for the potential hazards created thereby in confined spaces such as the cockpit will be used in or on aircraft.

2. **Emergencies.** Standard procedures for emergencies requiring bailout, ditching, and abandoning the aircraft shall be promulgated by all units operating aircraft. Appropriate instructions and placards will be maintained in all aircraft.

3. Distress Procedures

1. Distress radio frequencies, procedures, signals, and call signs may vary in different theaters of operations; hence, it is essential to be familiar with local operation orders and plans, fleet or force instructions, radio facilities, charts, etc.

2. A copy of the distress radio procedures and distress signals appropriate for the theater(s) of operation shall be carried in the cockpit of all naval aircraft, and they shall be used in time of peace regardless of the degree of radio silence which may be imposed during tactical exercises. In time of war, they shall be used as prescribed by competent authority and on special operations they may be amplified as necessary to cover local conditions.

3. A copy of the standard visual panel-type distress signals and procedures will also be carried in the cockpit of all naval aircraft.

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United States Navy
SAFETY PRECAUTIONS

Chapter 4
LAND TRANSPORTATION

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Subsection A
LOCOMOTIVE AND YARD SAFETY

04101 PERSONNEL

1. **Composition of Crews.** In Navy railroad operations the train crew shall consist of not less than one locomotive engineer and three trainmen, unless other arrangements have been approved by the safety division of the bureau having management control.

2. **Restrictions**

a. **LIMITS ON RIDERS.** No one but operating personnel shall ride railroad equipment except where cars have been provided for that purpose and authorization has been given by the commanding officer or transportation officer.

b. **WORK RESTRICTION.** No person other than a trainman shall couple or uncouple cars.

c. **CROSSING TRACKS.** Workmen shall not cross, walk along, or remain upon railroad tracks at any time unless it is absolutely necessary for them to do so in their line of duty. At such times the following rules shall be observed:

1. They shall always look in both directions for approaching trains, engines, or cars before crossing tracks, and step *over* the rails—never on them.
2. When an area has been especially designated as the proper place for crossing, they shall always cross there.
3. Crossing or standing on tracks close in front of moving trains, engines, or cars is prohibited.

4. In crossing, workmen shall keep at least 20 feet away from the end of a standing train, engine, or other rolling equipment, and they shall not loiter on the tracks. Above all, they shall never cut through a train under couplers.

3. **Boarding and Leaving Moving Equipment.** *Accident records show that one out of every four accidents with railroad equipment occurs when men are climbing on or off cars or locomotives.*

a. **PROHIBITION.** Boarding or leaving equipment moving at high speed is forbidden.

b. **USE OF REAR STEP.** Whenever practicable, get on or off moving equipment from the rear step.

c. **SAFETY IN BOARDING**

(1) *Sharp Look-out.* Before boarding or leaving equipment which is either standing or moving, crewmen should look in both directions to avoid coming in contact with structures or obstructions along the side of the track or with equipment on adjacent tracks.

(2) *Correct Method.* When boarding rolling stock of any description, put the body in motion in the direction in which the equipment is moving and, firmly grasping a convenient grab iron or tread of the side ladder, swing the foot nearest the equipment onto the lower tread of the ladder.

(3) *Station Employees.* Trains shall always

be brought to a full stop for station employees to board.

d. SAFETY IN LEAVING

(1) *Standing Equipment.* When leaving standing equipment, retain a handhold until a foot is firmly placed to avoid falling, slipping, tripping, or turning an ankle.

(2) *Moving Equipment.* When leaving a moving car, place the inside foot on the lower tread of the sill step and grasp a convenient tread of the side ladder; then, when sure of the ground beneath you, let go of the handhold, remove the foot from the sill step and, with the body inclined slightly backward and legs partly flexed, alight on the foot farthest from the equipment, using the other foot to overcome momentum.

4. Going Between Cars

a. WHEN CAR IS IN MOTION. Employees shall never go between moving engines or between engines and cars that are in motion.

b. BETWEEN OR UNDER STANDING CARS. If required to go between or under standing engines or cars to make repairs, inspection, or adjustments, workmen should have an understanding with those controlling the movement of such equipment that full protection has been provided against unexpected movement. Before going between equipment, workmen must always give a hand or lamp stop signal and wait for acknowledgement of the signal and slack adjustment, and they must be assured that the brakes have been properly applied.

c. NEED OF KEEN OBSERVATION. Workmen shall look in both directions before going between engines or cars, and, when stepping out from between equipment shall look both ways to avoid being struck by equipment in motion on adjacent tracks.

d. RIDING DROP-END GONDOLA CARS. When required to ride empty drop-end gondola cars, crewmen should assure themselves that the end-gate is secured.

04102 CARE OF YARDS AND CARS

1. Locomotive Inspection

a. CARS, CRANES, AND SHOVELS. A thorough inspection of all locomotives, locomotive cranes, and shovels in service shall be made daily by a

competent person or persons designated by the transportation office, and the defects found shall be corrected before any of this equipment is returned to service.

b. BRAKES AND LIGHTS. Before equipment is placed in operation, locomotive engineers shall check and test the brakes. Lights shall also be checked prior to night operation; all locomotives, locomotive cranes, and railway cars must have adequate lights, fore and aft.

c. REPORTING DEFECTS. Locomotives, locomotive cranes, shovels, and railway cars shall be maintained in a proper and safe condition while in service. All cases of defective equipment of any kind shall be reported in writing at once to the transportation office by the person using the equipment or discovering the defect. Written reports of such inspection shall be made.

2. General Safety

a. HAND AND FOOTHOLDS. All locomotives, railway cars, and shovels shall be equipped with proper grab irons, steps, and hand and footholds; they shall have railings on deck walks, and suitable running boards at the front and rear.

b. BRAKES. All locomotives, locomotive cranes, and railway cars shall be equipped with hand, air, or steam brakes, and with brake rigging. Special care shall be exercised to maintain these devices in an efficient condition.

c. PUSH POLES. Push poles in suitable brackets shall be provided on all locomotives. Such poles should be of straight-grained wood with ends made to fit the push caps, and should be banded with metal to prevent slipping or rounding. They should have disks on their handles to prevent the hands from being caught between the handle and the rail.

d. ARRESTERS. Where coal-burning steam locomotives are used, their smokestacks should be provided with arresters or hoods.

e. LOOSE MATERIAL. No material of any kind shall be so placed between or near railroad tracks as to present a hazard to anyone or reduce the track clearance.

3. Safety in Storage-Battery Locomotives

a. SWITCH SHIELDS. An electric-battery locomotive should be provided with a shield which prevents removal of the controller handle ex-

cept when it is in the "off" position; thus, the controller switch cannot be left in contact with one of the resistance points, thereby causing the point to overheat.

b. **INSPECTING AND SERVICING.** When inspecting, watering, or changing batteries workmen shall wear rubber gloves and acid-proof goggles.

4. **Safety in Internal-Combustion Locomotives.** Internal-combustion (gasoline or diesel-electric) locomotives shall be equipped with self-starters and have explosion-proof lights and switches at their fueling stations.

5. **Safety in Diesel-Electric Locomotives**

a. **OCCUPANTS OF ENGINE ROOM OR CAB.** Only authorized persons shall be permitted in the engine room or cab of any locomotive.

b. **RULES FOR PERSONNEL**

(1) *Clothing.* When working around diesel engines, personnel should always wear snugly fitting clothing to avoid creating a hazard near the moving machinery.

(2) *Wearing of Rings and Wrist Watches.* No work shall be performed on any electrical equipment by anyone wearing a ring, wrist watch, or other metal article.

(3) *Vee Belts.* Operators shall not install or adjust any Vee belts while the equipment is running.

c. **GENERATION OF HIGH VOLTAGE.** Diesel-electric locomotives, being fundamentally electric and not mechanical sources of power, are capable of developing electrical charges far greater than those encountered on steam locomotives. If contacted by the operator these charges can prove fatal, since the main generator's normal operating voltage in these engines varies from 500 to 1,000 volts of direct current and the voltage during transitions or sudden reversals may reach as much as 3,000 volts for brief periods. Operators not authorized to work on this equipment *must keep off while the power is on or when the locomotive is moving.*

d. **REPLACING A FUSE.** If a fuse blows, the operator shall not change it unless he can do so safely. The engine should not be operating when electrical equipment is being serviced. See chapter 18, article 18205-4.

e. **REMOVING GREASE AND OIL.** Grease and oil on the floor of diesel locomotives should be

cleaned up immediately. Operators should wipe these engines off frequently with a clean, lintless, dry cloth, since accumulations of dirt and grease around the wiring can cause flash-overs of current. Never use waste in the engine room or in any part of the locomotive; there is always the possibility that small particles of waste will find their way into the lubricating oil lines and clog them.

04103 FIRE PREVENTION

1. General Precautions

a. **EMERGENCY EQUIPMENT.** Each crewman should know the location of fire extinguishers and first-aid kits and any gear which might be necessary in an emergency.

b. **USE OF FLAMMABLES IN CLEANING ENGINE.** Operators shall never use gasoline or other flammable liquids to clean engines in operation, or to wipe the engine while it is running; some of the liquid might be trapped in the engine, diluting the lubricating oil, or the fumes might cause an explosion within the crankcase when the engine is started.

c. **DRAWING FIRE FROM LOCOMOTIVES.** Firemen shall always draw fire from locomotives at a specially designated spot, making certain that the locomotive is not at that time in close proximity to flammable liquids, gasoline storage tanks, wooden buildings, or any other flammable materials or equipment.

d. **ACCESS TO HYDRANTS AND FIRE PLUGS.** At no time shall transportation appliances be left standing or material placed at crossings in such a way as to obstruct the passage of fire apparatus to any hydrant or fire plug.

2. Precautions with Explosives

a. **EXPLOSIVES IN THE YARDS.** When explosives are present in railroad yards, the yards shall be considered to be explosive areas, to which all the general safety precautions regarding smoking, fire, and placarding apply. Because of the hazard inherent in large quantities of explosives, positive and effective fire protection measures shall be strictly observed.

b. **DISPOSAL OF SWEEPINGS.** When blasting powder or other explosives have been unloaded from a railroad car, the floor of the car shall be carefully swept immediately after the un-

loading and the sweepings poured into water and disposed of safely.

3. Preventing Fires in Storage-Battery Locomotives. In addition to taking the general precautions against fire when inspecting, watering, or charging batteries in storage-battery locomotives, personnel shall be prohibited from smoking or having any open flame in the vicinity.

4. Preventing Fires in Internal-Combustion Locomotives

a. BONDING AND GROUNDING. When fuel for internal-combustion locomotives is being transferred, fuel tanks shall be bonded and grounded (see article 17114). At all other times fuel openings shall be kept closed.

b. FIRE-EXTINGUISHING EQUIPMENT. Internal-combustion locomotives shall be equipped with fire-fighting appliances of the type approved for use in class B and class C fires.

5. Preventing Fires in Diesel Locomotives. For fire prevention in diesel locomotives see chapter 17, section 1, subsection B.

04104 SIGNALS

1. Personnel Involved. Through the use of lookouts and signals, every precaution shall be taken by train and engine crews, and by locomotive crane and shovel operators, to prevent possible injury to persons in the crew or in the yard.

2. Use of Standard Signals. The standard signal used on major railroad lines shall be used. When naval railroad equipment operates on mainline tracks it must comply with any special safety regulations of the private road with regard to lookouts and signals.

3. Vigilance in Obeying Signals. Enginemen should keep a constant and vigilant lookout for signals, and should observe closely the position of the switches affecting their movement. They shall never move equipment unless signals are in view. The disappearance from view of a signal is an indication for moving equipment to stop immediately, and an engineman receiving a stop signal must stop immediately, regardless of who gives the signal.

4. The Blue Loading Signal

a. PURPOSE. When workmen are loading or

unloading a car or cars in such a manner that a movement of the equipment might result in injury to other workmen, the supervisor in charge of the men shall place, at least 50 feet in front of the car at the open end of the railway spur, a standard railway blue flag and, in addition, a blue light by night, as a warning to train crews or others making a coupling.

b. OBEYING THE SIGNAL. Locomotives, locomotive cranes, or other rolling equipment must not enter upon the track which has a blue flag attached to it. When a locomotive must be run on a track adjacent to one displaying a blue flag everyone concerned shall take extreme care to insure the safety of the men working there.

c. REMOVAL OF SIGNALS. Blue flags or lights shall not be removed by anyone except the supervisor who placed them there, and he shall not remove them until the danger of injury to persons or the damage to property is no longer present.

5. Crossing Signals. Crossings shall be safeguarded by the use of such gates, bells, watchmen, lights, or prominent signs as will ensure safety. Special precautions shall be taken at dangerous crossings in congested parts of the yard or station. Watchmen stationed at such crossings shall be warned explicitly of the unusual hazards there, supplied with all necessary pertinent information (such as special trains using those tracks), and equipped with timetables showing the arrival time of scheduled trains.

a. USE OF THE ENGINE BELL. The engine bell must always be rung when the engine is about to move, and while the engine is approaching and passing over crossings.

b. THE RIGHT-OF-WAY. Ordinarily, railroad transportation equipment shall have the right-of-way over motor vehicles at street and road crossings, and a flagman carrying a red flag, unfurled, shall proceed ahead of the train to protect vehicular and pedestrian traffic. At "blind" street intersections in the yard, however, locomotives, locomotive cranes, and railroad cars must always be brought to full stop.

6. Switchmen's Hand Signals. Switchmen must give hand signals on the engineman's side, whenever practicable. At points where there are close clearances and switchmen find it nec-

essary to work on the fireman's side of the train, the fireman will receive the signals and communicate them to the engineman.

7. Emergency Signals

a. **THE RED SIGNAL.** The display of a red flag or red light indicates danger, and no one shall pass such a flag or light until it is safe to do so.

b. **FIRE.** When a fire signal sounds every reasonable effort must be made to clear crossings and buildings entrances and to keep them open until the all-clear signal has sounded.

c. **ACCIDENTS.** In cases of wrecks, derailments, and similar accidents, flagmen shall proceed along the track in both directions for a sufficient distance to stop trains running at their usual operating speeds, and shall place flags and torpedoes (by day), or fusees and torpedoes (by night), to warn oncoming trains in sufficient time for them to stop.

04105 OPERATING PRECAUTIONS

1. **Mainline Operations.** Naval railroad equipment operating on trackage owned by private railroad companies whose operations are governed by the United States Interstate Commerce Commission or the Public Utilities Commission of any State or Territory must conform to regulations of the regulatory body having jurisdiction.

2. Shifting and Switching

a. **REMOVING MATERIAL FROM CARS.** When shifting equipment at buildings, brakemen shall see that transfer plates, gangplanks, pallets, skids, wheel chocks, and any other material have been removed before coupling and moving cars.

b. **SECURING LOADS.** Crewmen should take care that all material on open cars is properly and securely loaded to prevent it from shifting or falling from cars or trucks. When opening or closing car doors, keep fingers clear of the edge or jamb of the door, rail, or casing by which the door travels, and keep the body clear of the opening made by the door to avoid injury from fingers being caught or material falling.

c. **STRETCHING DRAFTS.** All drafts must be stretched, to insure proper coupling, before being moved in either direction by a locomotive.

d. **CUTTING AIR HOSE.** All air hose must be cut by hand before cars are switched.

e. **MAXIMUM SPEED AT NIGHT.** A speed of 5 miles per hour shall not be exceeded when cars are being shifted at night.

f. **DANGER FROM FLYING SWITCHES.** Flying switches are dangerous to persons and property; all locomotives shall be brought to a full stop before the cars are cut loose.

g. GROUND LEVER SWITCHES

(1) *Operating.* When operating a ground lever switch a worker must keep all parts of his body clear of the line of lever travel. To avoid being struck by the lever or ball, the fingers and thumb should be under the lever when releasing it from its keeper. Similarly, when operating a ball switch, the hands and feet must be kept in a position where they will not be struck by the lever or ball.

(2) *Returning to Normal Position.* All switches must be sent back to their normal running track position after movements over them have been completed.

3. Operating Hand Brakes

a. **BRAKING UNATTACHED CARS IN MOTION.** When a box car or similar rolling stock not connected to a locomotive is being moved, a man should always be stationed on the equipment to operate the hand brake.

b. **TO SECURE A STANDING CAR.** When it is necessary to stop cars by the use of hand brakes, the brakes should be checked to be sure they are in good working order before cutting off the cars. All cars left standing must be secured with hand brakes or a similar locking device.

c. **PROPER POSITION WHEN OPERATING A BRAKE.** When operating a hand brake, crewmen should always take the proper position on the car, as indicated by the type of brake to be operated. They should be sure they have firm foot and handholds, to prevent slipping, falling, or experiencing a sprain or strain from losing their hold, footing, or balance. While applying the brakes they should put pressure on the wheel steadily (never with a jerk), especially when going from a light to a heavy pressure. Using any part of an adjoining car for a footrest when applying or releasing the brake is prohibited.

d. **MAKESHIFT HAND BRAKES.** A makeshift hand brake, such as is made by converting a

pick handle into a brake, should never be used. Such a stick is often of inferior material and is liable to break under pressure.

4. Making Couplings

a. **POSITION OF FEET.** When a coupling is being made or equipment is being moved brakemen shall not stand or ride with one foot on the engine or car and the other on the ground, or ride between cars or between the engine and a car with one foot on one car or the engine and the other foot on the adjoining equipment.

b. **COUPLING ON A CURVE.** Cars shall never be coupled on a curve.

c. **LINK-AND-PIN COUPLINGS.** When making link-and-pin couplings, brakemen shall use a hardwood stick to steer the link into position; they shall never use their unaided hands. The stick must be long enough to reach the link without subjecting their legs or hands to the danger of being crushed.

d. **PLACING THE PIN.** Brakemen must wait for the cars to stop before dropping the pin into place.

04106 UNLOADING RAILROAD CARS

1. **Clearance.** When freight is received by a freight car there shall be proper clearance between sidings, fixed poles, stanchions, and appurtenances. Clearly visible "NO CLEARANCE" signs shall be posted where necessary.

2. **Car "Spotting".** A railroad car shall be correctly and accurately spotted. If it is necessary to spot cars by hand, a standard car mover shall be employed, but before using a car mover be sure that everyone is in the clear.

3. **Use of the Blue Flag.** Proper warning signals and signs shall be posted when personnel are working in or unloading a freight car, and a blue flag or sign shall be posted at least 50 feet in front of the car at the open end of the railroad spur. Switchmen are not permitted to remove blue flags or lights. See article 04104, 4c.

4. **Securing the Car.** Before unloading a railroad car, crewmen shall make sure that the brakes are set and the wheels blocked, and that the gangplanks are held firmly in place. A track chock or rail clamp shall be used when explosives are being unloaded.

5. **Placing of Unloading Devices.** Unloading platforms, gangplanks, or roller conveyors of sufficient strength to support the material to be transported, shall be placed and securely fastened so that they cannot slip.

6. **Safety Wrenches.** Crewmen shall use safety wrenches to open drop-bottom cars.

7. **Marking of Trafficways.** Trafficways to buildings and storage areas shall be defined and clearly marked. They shall be designed to minimize cross-flow traffic and to avoid blind turns and corners.

Subsection B

SHOP SAFETY

04111 PERSONNEL PROTECTION

1. Personal Protective Equipment

a. **GOGGLES AND GLOVES.** Goggles shall be worn at all times where there is any possibility of flying particles striking the eyes. Gloves as well as goggles shall be worn when chipping, grinding, reaming, welding, or riveting.

b. **SHOES.** Safety shoes should be worn to avoid foot and toe injuries.

c. **PROTECTIVE CLOTHING IN DIESEL SHOPS.** Workers in filter-cleaning rooms of diesel shops

shall wear protective clothing of the following types:

1. moulded rubber splash-proof goggles, to protect the eyes against strong caustic solutions
 2. rubber gloves
 3. waterproof protective pads for arms and shoulders
 4. a waterproof apron
 5. safety shoes with heavy leather soles
- d. **EQUIPMENT MEETING NAVAL SPECIFICATIONS.** For detailed information on the use, mainte-

nance, and limitations of the various types of personal protective equipment which meet Navy Department specifications, see U.S. Navy Manual of Safety Equipment, NavExos, p 422.

2. Safety at Work

a. RIDING ON MOVING EQUIPMENT. Shop workers are not to catch rides on moving cars and engines.

b. BOARDING OR LEAVING. Workmen in engine repair shops shall always observe this important rule: *to board or leave an engine for any purpose, always face the engine*; then if slipping should occur, it is not likely to result in a serious injury.

c. GETTING OFF EQUIPMENT. When getting off railroad equipment, ladders, or platforms, mechanics should always look before stepping down, and should retain a handhold until the foot is firmly placed to avoid falling, slipping, tripping, or turning an ankle.

d. PROTECTION WHILE REPAIRING BRAKES. When starting to work on the brakes of an engine, the mechanic should first "cut off the air"; this will protect him from serious hand or finger injury should someone set the air while he is working.

e. STEAM IN THE ROUNDHOUSE. Workmen must never walk "blind" about the roundhouse or locomotive shed. When they cannot see through a cloud of steam they should stop and wait until the view becomes clear.

f. AVOIDANCE OF STRAIN. Workmen shall never attempt to lift very heavy equipment; they should either get help or use a hoist.

g. OBTAINING FIRST AID. First aid shall always be obtained promptly if a cut or other injury is sustained.

04112 SHOP HOUSEKEEPING

1. Ventilation. Adequate ventilation shall be provided in engine repair shops, to prevent the accumulation of carbon monoxide and other noxious gases when engines are inside the buildings.

2. Cleanliness. Cleanliness in engine repair shops is essential for accident prevention. Shop floors, corridors, ladders, catwalks, and passageways must be kept clear of loose material, trash, oil, and grease.

3. Disposition of Combustibles. Special recep-

tacles with self-closing lids shall be provided for such combustible material as greasy rags and waste. The contents of these receptacles shall be burned as often as is practical.

4. Disposition of Scrap. Scrap material shall be taken at once either to the scrap bin or the scrap tubs.

5. Avoiding Tripping Hazards. Tools, material and parts, hose and cable, etc. shall not be left lying where personnel may trip over them. They should be returned to their proper places after being used.

04113 WARNING SIGNS IN SHOPS

When locomotives are undergoing repairs, suitable warning signs as suggested below shall be prominently displayed on controls or in the vicinity of engine houses, cabs, cabinets, track ends, etc.:

DANGER—DO NOT MOVE
DANGER—MEN WORKING
UNDERNEATH
DO NOT OPEN—MEN WORKING
NO SMOKING
NO SMOKING BETWEEN SIGNS
DO NOT START THIS ENGINE
STOP UNITS BEFORE MAKING
REPAIRS IN THIS CABINET
DO NOT USE WASTE FOR CLEAN-
ING—USE RAGS

04114 PROPER USE OF EQUIPMENT

1. Safety Benches. Safety benches shall be used at the rear of a locomotive when the tender is disconnected and shall be used along the side of a steam locomotive when men are working there. Such benches can be either prefabricated wooden benches, horse scaffolds, or tubular staging.

2. Handling of Tools. The precautions for proper handling of portable tools will be found in chapter 16.

3. Lifting with Jacks

a. SELECTION OF PROPER JACK. Mechanics should always select the proper size of jack for the load to be lifted. A jack of too light capacity can strip itself, releasing the load; and a jack of too little height will run itself out before accomplishing the purpose intended.

b. INSPECTION. The jack should be inspected before use; if there is any doubt about its condition, it should not be used.

c. SEATING THE JACK. The jack should be placed on a firm footing, where it cannot slip or kick away from the load to be lifted. Welders working between gondolas or other types of railroad cars shall make sure that, if jacks have been placed at either or both ends of cars, they are firmly placed, with no possibility of tipping over.

d. BLOCKING. Jacks should be blocked after each hitch. Use the right size of wood blocking between the top of the jack and the load to be lifted, with a wedge, if necessary, to keep the jack at a right angle to the lift point to prevent tipping.

e. PLACEMENT OF TRESTLES. After jacking up a car, locomotive, or tender, safety blocks or trestles should immediately be placed under the truck or car body. Workmen shall never go under or work on such equipment when it is not protected by trestles or safety blocks.

04115 SAFETY IN WORK METHODS

1. Building Engine Fires

a. BEFORE OPENING THE FIREBOX. When building a fire on a live engine (one with a partial head of steam), the blower shall always be turned on before the firebox is opened.

b. USE OF FLAMMABLE LIQUIDS PROHIBITED. To start a fire, workmen shall never throw gasoline or other flammable liquid into the hot firebox of a locomotive, as the liquid may immediately vaporize and flare back, causing serious burns.

2. Working on Turntables and in Pits

a. PIT EQUIPMENT. Pits shall be equipped with vapor-proof lights and shall have steps or ladders at each end. The entire pit shall be enclosed by removable safety rails.

b. ENTERING THE PITS. No one shall enter a turntable pit without first locking the controls.

c. ENGINES ON TURNTABLES

(1) When Engine is Attended. No engine shall be operated while on the turntable, nor shall personnel jump from turntable, before the signal is given by the turntable operator. Any workman authorized to move an engine or any self-propelled unit within an engine house shall be held personally responsible for knowing positively that there is no person beneath the engine or self-propelled unit who might be injured by the operation of the throttle, change of position of the reverse lever, or operation of the brakes or injectors.

(2) When Engine is Unattended. Engines under steam or air pressure must be protected against movement while unattended, as follows: the valves shall be centered, the throttle tightly closed, the relief valve on the steam chests (or the valve chambers) opened, and the engine brakes applied. In addition, the wheels shall be blocked with proper blocking chain where conditions require such a precaution.

d. CROSSING THE PITS. Workmen shall always walk around the pits instead of jumping or stepping across them.

Section 2

MOTOR VEHICLES

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Subsection A

ADMINISTRATIVE RULES

04201 DEFINITIONS

As referred to in this section, the following definitions will apply:

1. **Vehicle.** A device used to transport persons or property except devices used exclusively upon stationary rails.

2. **Motor Vehicle.** A self-propelled vehicle.

3. **Emergency Vehicle.** Vehicles identified and authorized for use in accident prevention, protection, security, crash and rescue work, and those designated for emergency public works service.

4. **Truck.** A motor vehicle designed for the transportation of property.

5. **Truck Tractor.** A motor vehicle designed for drawing other vehicles.

6. **Trailer.** A vehicle without motive power designed for carrying persons or property and for being drawn by a motor vehicle.

04202 OPERATORS' QUALIFICATIONS AND REQUIREMENTS

1. **Operator's Permit.** No person, military or civilian, shall be permitted to drive a Government or private motor vehicle authorized for

use in conducting official business, until such person has been examined and issued a permit in accordance with Navy Civilian Personnel Instruction 190.9. Strict adherence to NCPI directives concerning records and accident reports is required.

2. **Inspection and Maintenance of Vehicles.** Motor vehicles shall be maintained in a safe condition and no operator shall be permitted or required to operate a vehicle known to be unsafe. Operators of Navy or Marine Corps motor vehicles shall make the daily and weekly inspection or maintenance of the items listed on DD form 110, Vehicle and Equipment Operational Record. Inspection findings and recommendations should be reported in the space provided, before, during, and after operation.

3. **Compliance with Local Ordinances.** Motor vehicle operators must obey all local traffic laws and ordinances, use and observe the hand signals authorized for turning and stopping, and comply with all traffic signs and signals. It is not intended that the rules given in the following articles shall conflict with any local laws or ordinances. In case of such conflict, the local law or ordinance will prevail. In countries.

where driving on the left side of the road is customary or legal, these rules shall be adapted to said custom or law.

4. Hours of Work. Except in extreme emergencies, where no relief is available, drivers of motor vehicles shall not be required to perform driving duties for long periods, because they may cease to be mentally alert and physically capable of driving safely. Drivers should not be required to perform driving duties, except for short hauls following a full day of fatiguing work.

5. Physical Fitness. No operator whose alertness is impaired by fatigue, illness, alcohol, drugs, or who is otherwise physically unfit may drive a Government vehicle. If an operator is on the road and feels that he is becoming fatigued or drowsy, he shall pull off the road and stop for a few minutes of rest.

6. Courtesy. Motor-vehicle operators are expected to practice "courtesy of the road" at all times toward drivers of other vehicles and toward pedestrians.

Subsection B

SAFETY OF THE ROAD

04211 BASIC RULES OF THE ROAD

1. Speed Regulations

a. LOCAL SPEED LIMITS. No motor vehicle shall be driven at a speed greater than the maximum limit allowable in the area or posted on the roadway.

b. RECKLESS DRIVING. No motor vehicle may be driven recklessly or in such a manner as to endanger life, limb, or property.

c. REDUCING SPEED. No motor vehicle may be driven at a speed greater than is reasonable and prudent, giving due regard to the type of vehicle, visibility, traffic, or any other existing condition or circumstance, such as:

1. approaching and crossing an intersection or railway grade crossing;
2. approaching a drawbridge or lift bridge;
3. approaching and going around a curve;
4. approaching a hill crest;
5. traveling in any narrow, winding roadway;
6. driving on a wet pavement, over snow or ice, or through rain, snow, sleet, fog, mist, dust, or smoke.

d. MINIMUM SPEEDS. No motor vehicle shall be driven at a speed so slow as to impede or block the normal, reasonable movement of traffic, except when reduced speed is necessary for safe operation.

2. Correct Lane. A motor vehicle shall be driven as nearly as practicable entirely within the right-hand lane and shall not be shifted

from that lane until the driver can accomplish the move with safety. Driving may be shifted to another lane under the following conditions:

1. when overtaking and passing another vehicle proceeding in the same direction;
2. when the right half of the roadway is closed to traffic because of construction or repairs;
3. when a roadway is marked for one-way traffic;
4. when the roadway is divided into three or four lanes and marked for traffic under the rules applicable thereon;
5. when preparing for a left turn at an intersection, a private road, or a driveway.

3. Safe Following Distance. The operator of a motor vehicle shall not follow another vehicle more closely than is reasonable and prudent, having due regard for the relative speeds of the vehicles, the amount of traffic, the conditions of the highway, visibility, and the type of vehicle directly ahead. When following fire apparatus responding to an alarm or other emergency vehicles, automotive traffic shall keep at least 500 feet to the rear of such vehicles.

4. Overtaking and Meeting Vehicles

a. MAINTAINING SAFE CLEARANCE. When overtaking another vehicle proceeding in the same direction, an operator shall pass to the left of that vehicle and at a safe distance from it. He shall pass only when sure that the road-

way ahead is clearly visible and free of on-coming traffic for a distance sufficient to ensure safe completion of the passing. He shall not return to the right side of the roadway until safely clear of the vehicle passed, but must at the same time be back in his own lane before coming within 100 feet of any vehicles approaching from the opposite direction.

b. PROCEDURE FOR OPERATOR OF OVERTAKEN VEHICLE. Except when overtaking and passing on the right is permitted, the operator of an overtaken vehicle shall, upon audible signal, give way to the right and shall not increase the speed of his vehicle until completely passed by the vehicle approaching from behind.

c. OVERTAKING AT NIGHT

(1) *Signal when Passing.* When ready to pass a vehicle at night, drivers shall flash their headlights as a signal to the vehicle ahead. If the way is clear the vehicle ahead should return the flash as a signal to pass.

(2) *Signal when Overtaken.* When overtaken by a vehicle at night, upon a flash from the overtaking vehicle's headlights, an operator shall return the flash if the way is clear, then permit the overtaking vehicle to pass.

d. WHEN PASSING IS PROHIBITED. Passing on the left is prohibited in the following situations:

1. When approaching the crest of a grade or a curve in the highway where the operator's view is obstructed to such a distance as to create a hazard in the event that another vehicle is approaching; or
2. when the view is obstructed within 100 feet of any grade, crossing, bridge, viaduct, or tunnel.

e. OVERTAKING ON THE RIGHT. Passing on the right is permissible *only when State and local laws permit* and then only under the following conditions:

1. when the road is clear and passing can take place without driving off the highway or incurring danger of any kind;
2. when the highway is of sufficient width that there are two or more lanes for moving traffic in each direction; or
3. when the vehicle is on a one-way street or highway of at least two lanes and there are no obstructions.

f. PASSING STANDING STREETCAR OR BUS. Unless protected by safety zones, a standing streetcar or bus taking on or discharging passengers should not be overtaken and passed on the right.

g. MEETING OTHER VEHICLES. When meeting other vehicles, operators shall keep their vehicles to the right-hand side of the road. In addition, the following precautions shall be taken in the specific situations given:

(1) *Meeting Other Vehicles at Night.* When driving with headlights on, beams must be depressed when meeting other vehicles.

(2) *Overtaking or Meeting a Standing School Bus.* Upon meeting or overtaking from either direction, a school bus which has stopped for the purpose of receiving or discharging school children, a driver shall stop his vehicle before reaching the bus and shall not proceed until the bus resumes its motion or until signaled ahead by the driver. Local ordinances regarding meeting and overtaking school buses shall be observed.

5. Right-of-Way

a. AT INTERSECTIONS. When approaching an intersection the operator shall reduce the speed of his vehicle and be prepared to stop and shall observe the following rules as to right-of-way:

1. When approaching an intersection he shall yield the right-of-way to a vehicle which has already entered the intersection from a different highway.
2. When a motor vehicle is entering an intersection at approximately the same time as a vehicle from a different highway, the vehicle on the left shall yield to the vehicle on the right.
3. The operator of a motor vehicle about to enter or cross a highway from a roadway leading from a naval activity or private driveway shall yield the right-of-way to all vehicles approaching on the highway.

b. ON APPROACH OF AN EMERGENCY VEHICLE. Upon the approach of an authorized emergency vehicle (fire department truck, ambulance, police or military patrol) giving warning by sirens or bells or by at least one lighted red light, the operator of a motor vehicle shall yield the right-of-way, drive immediately to a position parallel and as close as possible to the

right of the roadway, clear of any intersection, and remain there until the emergency vehicle has passed.

6. Backing and Maneuvering. The operator of a motor vehicle shall make certain that the way is clear before backing or maneuvering.

7. Stopping and Parking Motor Vehicles

a. SLOWING TO A STOP. Operators should always stop their vehicles slowly. A quick stop may injure a passenger, move the load, or cause a crash with a vehicle immediately behind.

b. PARKING ON A ROADWAY. The operator of any motor vehicle upon any highway outside of a business or residential district shall not stop such vehicle, park it, or leave it standing, whether attended or unattended, upon the paved or traveled part of the highway, when it is practicable to stop such vehicle, park it, or leave it elsewhere; and, in any case, an unobstructed width of the highway opposite a standing vehicle shall be left for the free passage of other vehicles, and a clear view of the stopped vehicles shall be available from a distance of 200 feet in each direction upon the highway. These regulations are not binding in cases of disabled vehicles. See article 04212,1.

c. STOPPING ON A GRADE. When parking on a grade an operator, in addition to effectively setting the brake, shall place the vehicle in low gear or put the selector in the "park" position. In addition, if he is parking downgrade he shall turn the front wheel sharply toward the right side of the highway, and if he is parking upgrade he shall turn the front wheels to the left. Thus the vehicle will be stopped by the curb or will turn off the highway in the event that it rolls while unattended.

d. SECURING A PARKED VEHICLE. The operator in charge of a motor vehicle shall not leave his vehicle unattended without first stopping the engine, locking the ignition, removing the key, and effectively setting the brake. As additional precaution the vehicle should be placed in low gear or the selector put in the "park" position.

04212 CARE OF VEHICLES

1. Signals Used During Emergency Stops. Whenever any motor vehicle is disabled upon

the traveled portion of any highway or the shoulder thereof, outside any municipality, at any time when lighted lamps are required on vehicles, the operator of such vehicle shall display warning devices upon the highway during the time the vehicle is so disabled. Motor trucks, buses, or truck-tractors shall carry at all times two red flags not less than 12 inches square and equipped with standards to be used as daylight warnings. Any such vehicle operating from one-half hour after sunset to one-half hour before sunrise shall also carry three red electric lanterns or three red reflector flares, three pot torches, and three fusees. (Fusees are required only if pot torches are used). When such vehicles carry flammable liquids in bulk, compressed flammable gas, explosives, or any other highly inflammable cargo, only the required electric lanterns or reflector flares shall be carried in addition to the flags. The equipment shall be used as follows:

a. POT TORCHES AND FUSEES. In the event that pot torches and fusees are provided as warning equipment, a lighted fusee shall immediately be placed on the roadway at the traffic side of the vehicle. Within the period the fusee is burning or as promptly as possible thereafter three pot torches shall be placed on the roadway, as follows: one each at a distance of not less than 100 feet (40 paces) or more than 300 feet in advance and to the rear of the vehicle (each in the center of the lane of traffic occupied by the disabled vehicle), and a third at the traffic side of the vehicle, approximately 10 feet to the rear or ahead thereof.

b. REFLECTOR FLARES AND ELECTRIC LANTERNS. Whenever the disabled vehicle is equipped with electric lanterns or reflector flares, one electric lantern or reflector flare shall immediately be placed on the roadway at the traffic side of the vehicle, and two electric lanterns or two reflector flares shall be placed to the front and rear of the vehicle in the same manner as heretofore described for pot torches

c. RED FLAGS. Whenever any motor truck, bus, tractor, trailer, semitrailer, or pole trailer is disabled upon the traveled portion of a highway or the shoulder thereof outside any municipality, at any time when the display of flares, electric lanterns, or reflector flares is not re-

quired, the driver of such vehicle shall display two red flags upon the lane of traffic occupied by the disabled vehicle, one at a distance of not less than 100 feet (40 paces) or more than 300 feet in advance of the vehicle, and the other not less than 100 feet or more than 300 feet to its rear.

2. Precautions with Gears and Brakes

1. When a vehicle is proceeding down grade its clutch should not be disengaged. On steep grades forward movement should be retarded by placing the vehicle in second or low gear, depending on the steepness of the slope.

2. Vehicle operators shall never proceed down a steep incline or on ice with the overdrive engaged.

3. Never apply the brake suddenly or forcibly when traveling over slippery pavement.

3. Towing Vehicles

a. **USE OF TOW TRUCK.** Except in emergencies only such Navy-owned motor vehicles as are especially designed for the purpose shall be used for towing or pushing another vehicle.

b. **USE OF RIGID CONNECTION.** A towbar or similar rigid connection should be used for towing.

c. **BLOCKING AND UNCOUPLING.** Both vehicles must be completely stopped before they are uncoupled, and if necessary the wheels should be blocked. No one shall be allowed to go between the vehicles to uncouple them until it is certain both vehicles are securely stopped.

4. **Use of Skid Chains.** The responsibility for using or not using skid chains rests entirely upon the operator. Chains add to traction in starting and stopping in heavy snow, soft ice, and mud but, even with chains, reduced speeds and additional care are necessary in slippery weather. Chains should be put on when they will give added traction and safety, and removed when clear pavement is reached.

5. **Fueling Vehicles.** In addition to the instructions contained in article 04226, the following precautions shall be taken when a motor vehicle is being fueled:

1. No fueling shall take place when there are passengers aboard.

2. No fueling shall be done within a closed building.

3. During fueling the operator shall not smoke or light a match or lighter for any reason and there shall be no open flame in the vicinity.

4. Operators shall turn off engine and vehicle lights while taking on fuel.

6. **Use of Fire Extinguisher.** Operators are required to familiarize themselves with the operation of fire-extinguisher equipment carried by motor vehicles, and to be prepared to operate the extinguishers in case of fire.

04213 SPECIAL TYPES OF VEHICLES

1. **Buses.** The following rules for the operation of buses are supplementary to those applying to all motor vehicles:

a. GENERAL PRECAUTIONS

1. Only operators with satisfactory records of safe driving shall be assigned to drive buses.

2. Operators must be trained to stop, start, and operate buses smoothly and without jerks or sudden changes in acceleration.

3. Operators must not start or operate buses with the doors open.

4. Operators must not close the doors of buses until passengers are fully inside and off the steps.

5. When making a turn or upon approaching a sharp curve, operators must reduce speed and use care to avoid injuring passengers.

6. The bus operator shall give his attention to the road when driving and shall not carry on unnecessary conversation with the passengers while the vehicle is in motion.

7. Operators of fare-charging buses shall not make change while the bus is in motion.

b. **SCHOOL BUSES.** The driver of a school bus is required to exercise all precautions listed above in addition to the following special precautions:

(1) **Speed.** No school bus shall be driven at a speed greater than that authorized by the laws of the State in which the vehicle is being operated. When children are on the bus the speed shall be not more than 45 miles per hour.

(2) **Orderly Conduct.** Passengers shall be

under the authority of and directly responsible to the operator of the bus, and the operator shall be held responsible for the orderly conduct of the pupils for their safety.

(3) *Regular Stops.* Pick up or discharge of any passenger except at regular stops designated by commanding officers of their representatives is prohibited.

(4) *Crossing Street.* Whenever a school bus stops to discharge passengers who must cross the street or highway in order to reach their destination, such passengers must cross in front of the bus, except when laws regulating local traffic prohibit this. In any case, the bus shall not be started until passengers desiring to cross have done so.

(5) *Escorting Children.* The operator of a school bus shall not permit pupils to cross a street or highway until they can do so safely, and he shall, if necessary, secure the bus, dismount, and act as their escort.

2. *Ambulances.* Operators of ambulances shall follow the general safety rules for motor vehicle operators in addition to the rules in this chapter. See also article 21204.

a. *AUTHORIZED USE.* Ambulances shall be used only for the transportation of the sick, injured, or wounded, and such personnel as are required to attend them.

b. *EMERGENCY RUNS.* Emergency runs shall be restricted insofar as practicable. Only commanding officers, their representatives, or duty officers may authorize emergency runs or prescribe the circumstances under which they may be ordered. Each emergency run shall be fully recorded in the duty log of the medical department having local control.

c. *INSTRUCTION OF OPERATORS.* The transportation officer shall make certain that ambulance operators are thoroughly conversant with local traffic regulations and local geography.

d. *SPEED LIMITS.* A limiting speed shall be set for each ambulance, for any and all circumstances, according to local traffic regulations and conditions applicable to operation of "emergency type" vehicle.

e. *STOP LIGHTS.* No operator of an ambulance shall proceed through a red light stop signal or a fixed stop sign except in cases of extreme emergency, and then only after slow-

ing down and determining that it is safe to continue.

3. *Motor Fire Apparatus.* Engineers and drivers of structural fire-fighting motor apparatus shall observe the following safety precautions:

a. *AUTHORIZED RIDERS.* No person other than a member of the fire department shall be permitted to ride on fire apparatus, except when authorized to do so by the fire marshal or fire chief.

b. *WARNING DEVICES*

1. Red lights and sirens shall be used as emergency warning signals in responding to alarms.

2. Sirens on motor vehicles shall not be sounded except when responding to an alarm.

c. *SPEED*

1. Motor fire apparatus shall be driven at a safe speed under all conditions and shall not be driven in excess of 35 miles per hour in responding to an alarm of fire.

2. Fire apparatus shall be slowed down, and brought to a stop if necessary, before crossing dangerous intersections or crossing streets against red traffic lights.

d. *PARKING AT THE SCENE OF FIRE.* Fire apparatus shall not be parked or left standing at the scene of alarms in such a manner as to unduly obstruct traffic, and free flow of traffic shall be established as soon as possible.

e. *RETURNING TO FIRE STATION*

1. Motor fire apparatus, when returning from an alarm of fire, shall be driven as nonemergency equipment and the drivers shall abide by all traffic regulations of the station, and of state and local traffic laws when off the station.

2. The fire apparatus shall not be backed into the fire station or backed up at any time without a man on the rear platform directing the driver. Any member standing near where a piece of equipment is being backed shall guide the driver.

4. *Trucks and Trailers*

a. *CHECKING EQUIPMENT BEFORE OPERATING.* No trucking equipment shall be operated unless it is in good repair and all safety devices are in proper working condition. Hood fast-

eners, brakes, brake fluid, headlights, horn, windshield wiper, king pins, breakaway brakes, etc., shall be inspected and repaired. All tires on dual wheels shall be matched as to size, weight, load capacity, and air pressure. Trucks and tractors equipped with air brakes shall not be operated until the air pressure in the braking system registers 65 pounds. Trucks that operate during hours of darkness shall be equipped with proper headlights, tail lights, and running lights.

b. TRANSPORTING PERSONNEL. Trucks or trailers while carrying cargo shall never be used to transport personnel, and dump trucks shall never be used for the purpose. Within Government reservations, empty trucks may be used to transport small groups (less than 12 persons) of seated passengers for short distances. No part of any passenger's body shall extend beyond running lines of the truck or trailer.

c. LOADING

(1) Maximum Size of Load. No motor vehicle shall be loaded beyond its rated capacity, and it shall not have any part of the load extending over the sides of the vehicle except when clearance has been obtained from local civil authorities to transport larger loads. Further, the load shall not obscure the operator's view ahead or to either side, or in any way interfere with safe operation.

(2) Distributing the Load. Heavy loads must be properly distributed. Incorrect distribution may overload individual tires or axles even though the weight of the load is within the rated capacity of the vehicle.

(3) Securing the Load. The load of a vehicle should be so arranged that none of the cargo can drop, shift, leak, or otherwise escape. The load must be braced and stayed with proper lines, chains, dunnage or other fittings. The operator is responsible for the load and is authorized to refuse cargo that is improperly loaded. On trucks or trailers used for carrying high, bulky material, side stakes shall be installed to hold the load securely in place. Tailgates of all trucks and trailers must be secured before the vehicle is operated.

(4) Warning Signs. A motor vehicle carry-

ing a load which projects more than 4 feet beyond the rear of the vehicle shall display at night, or whenever visibility is reduced, a red light at or near the end of the projecting material. At other times, a red flag not less than 12 inches square should be displayed in place of a red light.

(5) Loading a Dump Truck. The operator of a dump truck shall not sit in the cab of the truck while it is being loaded by a power shovel, crane, derrick, or similar device. He should leave the driver's seat and remain outside the reach of the dipper or bucket until the truck has been loaded.

(6) Hauling of Heavy Loads. No vehicle hauling an unusually heavy load over a highway or within a municipality shall be moved until the operator has been advised of the correct weight of the vehicle and load, and given specific instructions as to the route which he is to follow (one which has previously been chosen as safe and legal).

d. TOWING

1. No truck or tractor shall pull or tow a draw-bar type trailer over the public highway or within the activity unless both vehicles are connected by double safety chains and chains are properly secured.
2. Trucks or tractors equipped with air brakes shall tow only trailers equipped with air brakes. Coupling of vacuum brake unit to air brake unit is strictly prohibited.
3. No truck or tractor shall pull or tow any trailer until proper air connections are established between the two units.

04214 SAFETY FOR RIDERS

1. Restrictions on Riders

a. UNAUTHORIZED RIDERS. Under no circumstances shall unauthorized persons be allowed to ride on a motor vehicle.

b. CROWDING THE OPERATOR. In addition to the operator there shall be permitted in the front seat of a motor vehicle only the number of passengers for which the seat was designed.

c. STANDING. Standing in moving vehicles

is prohibited except in buses provided with handholds or straps.

d. CONTAINMENT OF PASSENGERS WITHIN VEHICLE. Under no circumstances shall any person be permitted to ride with arms or legs extended outside any vehicle, to ride on running boards, or to be seated on fenders, the top of the cab, cab shields, or the rear of the load, except when the vehicle is designed and has provision for such purpose.

2. Restriction on Vehicles Used. Trucks being used to transport personnel shall be equipped with seating facilities which are secured, and with a rear endgate or guardrail properly secured. Such trucks shall not be moved until the operator has assured himself that all persons are seated and that the required guard rails and endgates are secured. Riders shall never be permitted in the bed of a dump truck.

3. Carrying Equipment on Vehicles with Riders

a. STOWAGE OF TOOLS. Tools and equipment carried on a motor vehicle which also carries riders shall be properly stowed and fastened.

b. PROHIBITION AGAINST EXPLOSIVES. No explosives, flammables, or toxic substances shall be transported in a vehicle while it is being used to carry riders other than authorized workmen.

4. Protection in Cold Weather. All open motor vehicles transporting personnel during cold or inclement weather shall be provided with a tarpaulin or other suitable covering.

5. Loading and Unloading Personnel. No person shall be permitted to get on or off a motor vehicle while it is in motion. Vehicles shall be brought to a complete stop before loading or unloading passengers.

04215 TRANSPORTING EXPLOSIVES

The transportation of explosives is extremely hazardous by any method, and the dangers of transporting by motor vehicles are multiplied because of the high rate of highway accidents. All rules for road safety must be carefully studied by operators of motor vehicles carrying explosives, and in addition the special precautions of this article shall be closely followed.

1. Applicable Regulations. The transportation of explosives shall be in compliance with Interstate Commerce Commission regulations and any local, State, and municipal regulations which apply to highway transportation.

2. Qualified Personnel. Every vehicle used for the transportation of explosives shall be under the supervision of and operated only by a person who is properly qualified, physically fit, careful, reliable, and able to read signs and labels written in the English language or language prevailing in country or countries being traversed. No person other than the authorized driver and one helper shall be permitted to ride on a vehicle transporting explosives.

3. Preparation of the Vehicle

a. VEHICLE INSPECTION. Vehicles used in the transportation of explosives shall be inspected immediately before use, and a record of such inspection kept, in order to determine that:

1. all fire extinguishers are filled and in good working order;
2. electric wiring is effectively insulated and firmly secure;
3. chassis, engine, pan, and bottom of body are clean and free from surplus oil and grease;
4. gasoline tank and feed line have no leaks;
5. brakes and steering apparatus are in good condition;
6. the vehicle is in all other respects in proper condition for handling explosives.

b. COVERING EXPOSED METAL. Any exposed ferrous metal on the inside of the body of the vehicle that might come in contact with a package of explosives shall be covered or protected with wood or other nonmetallic cushioning material before the explosives are loaded.

c. FIRE EXTINGUISHERS. Each vehicle used for the transportation of explosives shall be equipped with not less than two fire extinguishers of adequate capacity and of a type listed by the Underwriters Laboratories for Class B fires. They shall be placed at readily accessible points, filled, and ready for immediate use.

d. WARNING SIGNS. Every vehicle used for the transportation of explosives shall be

marked or placarded on front, sides, and rear with the word "EXPLOSIVES" in letters not less than 3 inches high, in a color contrasting with the background, or the vehicle shall conspicuously display, at both front and rear ends, red flags not less than 24 inches square, marked with the word "DANGER" in white letters not less than 6 inches high, such flags to be kept open and readable by means of appropriate stiffeners. Each vehicle shall also be provided with three red flags and appropriate stands and with three electric flares or reflectors, to be used in case of emergency stops as described in article 04212.

4. Loading and Unloading Explosives

a. RESTRICTIONS ON LOAD

(1) *Keeping to Rated Capacity.* Vehicles used for transportation of explosives shall not be loaded beyond their manufacturer's rated capacity, and in no case shall the explosive container be piled higher than the closed sides and ends of the body. If the vehicle has an open body, the sides and ends shall be securely fastened and the explosives shall be covered with a fire-, water-, and weather-resistant tarpaulin.

(2) *Carrying Other Substances.* No metal, tools, carbides, oil, firearms, electric batteries, flammable substances, acids, or oxidizing or corrosive compounds shall be carried in the body of any vehicle while it is being used for transporting explosives.

b. CARE DURING LOADING AND UNLOADING

(1) *Stopping Engine.* The engine of a vehicle shall be stopped during loading or unloading of explosives. Packages or containers of explosives unloaded from a vehicle shall be placed at a sufficient distance from the exhaust to prevent the danger of engine sparks igniting the explosives.

(2) *Proper Handling.* Packages or containers of explosives shall not be thrown or dropped while being loaded or unloaded. They shall be carefully deposited and stored or placed in such a manner as to prevent the packages or containers from sliding, falling, or being displaced. When being unloaded they shall be stored directly in a magazine or a responsible person shall be put in charge of them.

(3) *Provision for Loading Dynamite.* If State and local laws permit, dynamite and detonators may be transported in the same vehicle provided that the amount of dynamite in such instances does not exceed one case (50 pounds) and the number of detonators does not exceed 100. When dynamite and detonators are transported in the same vehicle they shall be separated by a divider of not less than 4-inch hardwood or material of equivalent resistance. Separate vehicles shall be provided for the transportation of more than one case (50 pounds) of dynamite or more than 100 detonators.

5. Safety in Driving

a. *WEATHER CONDITIONS.* Explosives should not be transported during hours of darkness or during adverse climatic conditions except in an extreme emergency and then only with the written approval of the proper authority and when all precautions have been taken.

b. *AVOIDING CONGESTED AREAS.* Transporting explosives through cities, towns, and other congested areas shall be avoided when possible. When unavoidable, the proper official of the area should be advised of the proposed trip in order to assure the use of the most desirable thoroughfare and to provide an escort if necessary.

c. *DRIVING SPEED.* Vehicles transporting explosives shall be operated with extreme care and shall be driven at a safe speed, in no case greater than 35 miles per hour.

d. *STOPS.* When explosives are being transported no unscheduled stops shall be made, and at scheduled stops the vehicle shall never be left unattended. Stops for refueling, crossings, and emergencies shall be in accordance with the following rules:

(1) *Railway Crossings.* Before crossing at grade level of any railroad track or tracks, the operator of any motor vehicle carrying explosive substances or flammable liquids shall stop his vehicle, preferably within 50 feet but not less than 15 feet from the nearest rail of such railway; while stopped he shall look and listen in both directions for approaching trains, and shall not proceed until he can do so safely. Upon proceeding he shall cross only in such

gear of the vehicle as will make unnecessary a change of gears while on the tracks. No stop need be made at any such crossing where a police officer or traffic-controlled signal directs traffic to proceed.

(2) *Refueling.* The gasoline tank of a vehicle shall not be refueled while explosives are in the vehicle except in an emergency, and then only after the engine of the vehicle is stopped, all lights are extinguished, and suitable ground for static electricity is attached.

(3) *Emergency Stops.* If an explosive-carrying vehicle becomes disabled in any way the operator shall, if possible, drive it off the street or highway before coming to a stop.

If this is not possible, two red flags in stands (in the daytime) or two electric flares or reflectors (at night) shall be so placed on the street or highway in the line of approaching traffic as to provide visibility for a distance of not less than 500 feet ahead and behind the stopped vehicle, and one red flag (in the daytime) or electric flare or reflector (at night) at the side of the vehicle to indicate restricted clearance for passing traffic.

6. *Use of Public Garage.* A vehicle containing explosives shall not be taken into a garage or repair shop, nor parked in a congested area, nor stored at any time in a public garage or similar building.

Subsection C

GARAGE SAFETY

04221 GENERAL HOUSEKEEPING

1. Cleanliness

a. *FLOORS AND OTHER EXPOSED AREAS.* The distribution center, garage, or workshop shall be thoroughly inspected daily and maintained in a clean and orderly state. Floors and other exposed surfaces shall be kept scrupulously clean. Hazards on floors such as oil, grease, or loose tools, which might result in fire, slipping, tripping, or falling shall be eliminated as quickly as possible.

b. *GREASE RACK.* Particular care shall be taken to maintain cleanliness in the area around the grease rack as well as in the rack itself. Be sure that grease connections are fast to car connections when greasing a car. At the close of business each day, clean the grease rack and floor.

c. *WALKS AND DRIVES.* Loose stones or gravel on walkways and driveways shall be removed daily. Keep walks and drives free of ice in winter, and remove icicles from the eaves.

2. *Ventilation.* Garages and repair shops should be well ventilated for protection against carbon monoxide gas from running engines. If the shop cannot be sufficiently ventilated to ensure maximum safety, a vehicle should be driven outside as soon as its engine has been started.

3. *Illumination.* Adequate illumination shall be provided and utilized for all general work areas, including work benches, lubrication pits, and other work locations. For minimum lighting required in specific situations see chapter 2, article 02204.

4 *Safety During Repairs.* Use warning signs or barricades to protect personnel when construction, repair work, or painting is in progress.

5. *Avoiding Tripping Hazards.* Covers on sidewalk boxes, fuel tanks, and pipe openings shall be flush with surfaces and shall be kept closed when not in use. All tools and equipment shall be kept in their proper places when not in use and shall particularly be kept out of walkways to avoid tripping hazards.

6 *Checking Overhead Fixtures.* Check overhead signs frequently to make certain that they are secure.

04222 PROTECTION OF PERSONNEL

The following personnel protective equipment shall be used by workmen in a distribution center, garage, or workshop:

1. *Apparel Required.* Mechanics shall wear goggles, rubber gloves, aprons, safety shoes, and special gloves as needed.

2. **Goggles.** Goggles shall be worn for all grinding, chipping, cutting, and welding work, or similar operations designated by local command and when using compressed air. See article 11402 for proper shade numbers of filter lenses for gas cutting, gas welding, or electric welding work.

3. **Prohibition Against Rings.** Rings shall not be worn by workmen servicing batteries or working on motor vehicles.

04223 FIRE PREVENTION

1. **Fire-Fighting Apparatus.** Fire-fighting apparatus shall be kept in proper working condition and well distributed, with locations conspicuously marked. Garage personnel should be trained in the operation of this equipment.

2. **Smoking.** Smoking or the carrying of lighted cigars, cigarettes, or pipes near pumps, batteries or vent pipes shall be prohibited.

3. **Handling Gasoline.** For a detailed treatment of the characteristics of gasoline and the fire hazards involved, see chapter 17 and article 04226 below.

04224 EQUIPMENT AND TOOLS

For a detailed understanding of the care and use of tools, personnel shall study chapter 16 of this manual. It will be noted also that article 04225 below contains information as to care of tools and equipment where such care is a part of servicing or in direct relation to it. Articles 04224 and 04225 should therefore be studied as a unit.

1. General Rules

1. Keep tools in their proper places when not in use.
2. Use only the correct tools for a particular job.
3. Never use defective tools.
4. Try to keep tools and hands free of grease. Clean tools with an approved solvent.
5. When using a bar on springs, work the bar away from your face. Be sure that you have a secure footing and that your body is braced.
6. Use wrenches that fit the task at hand.
7. Lift batteries with tongs.

2. **Blow Torches.** Blow torches shall not be used to clean crankcases, transmissions, radiators, or grease guns; steam, hot water, or suitable degreasers shall be employed for this purpose.

3. **Grease Guns.** Grease guns must be handled carefully and used only for the purpose intended. Serious injury has resulted when grease has been shot out of a grease gun in horseplay; *never* point the gun toward another person.

4. **Lube Dispenser.** Keep the dispenser where it will be out of the way, and check it at regular intervals for leaks.

5. **Mobile Grease Cart.** The mobile grease cart must be returned to its proper place immediately after it is used, and the hose must never be left lying along the floor.

6. **Air Compressors.** See chapter 6, article 06303 for detailed precautions as to the general care, cleaning, and repair of air compressors. Compressor tanks shall be tested periodically in accordance with the *Bureau of Yards and Docks Manual*.

04225 REPAIRING AND SERVICING VEHICLES

1. Body and Engine Work.

a. **ENTERING THE GARAGE.** When a car is being driven into a garage, personnel shall stand well out of its path. Never try to service a moving vehicle.

b. **SECURING THE HOOD.** Work shall not be started under a hood of a vehicle unless the hood has been firmly secured in the open position. Hood holddown clamps or locking devices shall be kept in good condition. Additional holddown clamps should be installed where necessary.

c. **BROKEN GLASS.** Care shall be taken to avoid injuries from broken windshields, light globes, lenses, or jagged pieces of metal around the car.

d. **RADIATOR.** If the radiator is steaming, the hands should be protected with a large rag, and the steam allowed to escape, before removing the cap entirely. Matches shall not be used when looking into a radiator.

e. **CRANKING THE ENGINE.** If it is necessary to crank an engine by hand, the brake must

first be set and the gearshift placed in neutral. In cranking, the handle should be grasped with the thumb alongside the fingers, and not around the crank. If possible, start the engine by a series of quick pulls. Spinning should always be started with an *upward pull*; never with a downward thrust.

f. LIFTING HEAVY PARTS. To prevent personal injury when removing or replacing heavy parts, such as gear units or hub and drum assemblies, mechanics should always use a hoist, jack, or dolly.

g. RESTRICTION ON LEADED GASOLINE. Do not use gasoline containing tetraethyl lead for anything but motor fuel. If this type of gasoline is spilled on the body, wash it off thoroughly, as it is a deadly poison.

2. Vehicle Stands. Approved metal vehicle stands should always be used when work is being done under a vehicle from which the wheels have been removed. Wooden blocks or horses shall not be used for this purpose. Hydraulic lifts are permissible, however.

3. Dump Trucks. Before starting repairs on the body of a dump truck, the truck must be properly blocked, either with sturdy wooden timbers or with the triangular steel stands designed especially for use on these vehicles.

4. Working on Raised Vehicles

a. JACKS

(1) *Inspection.* Jacks shall be inspected visually for cracks, looseness, and wear. If there is any doubt about the condition of a jack, it must not be used.

(2) *Blocking.* Be certain that a vehicle is properly blocked when working under it. Do not depend entirely on jacks.

(3) *Centering.* Center the service jack on the axle when a wheel is to be removed from a car. The jack should always be set on a solid footing.

(4) *Capacity.* Never use a jack for a load in excess of its rated capacity.

(5) *Handle.* Place the jack so that the swing of its handle will be unobstructed. Never leave a jack standing under a load with the handle in the socket.

(6) *Keeping Clear.* Never lean over a jack handle or handle socket under load. Keep the

body clear of the car, in case it should suddenly start to roll.

b. HYDRAULIC LIFTS

(1) *Inspection.* Inspect hoists at regular intervals for oil leaks, oil level, and proper lubrication. Check overhead connections at regular intervals, and make frequent inspections of safety locks on gears; the teeth of gear locks should not be worn or chipped. Never use a defective hoist.

(2) *Putting Vehicle on Lift.* Do not stand in front of a hoist while a motor vehicle is being guided onto it.

(3) *Checking Vehicle.* Never permit occupants to remain in a vehicle when it is to be lifted. Be sure, before lifting a vehicle, that the ignition is off, the gears are in neutral, the wheels are blocked, and the doors are closed.

(4) *Securing Vehicle.* In addition to the chocks provided on the lift, place additional chocks at the front and rear wheels of the car, as an added safety measure.

(5) *Freewheel Lift.* If the freewheel type of lift is used, be sure the car is properly balanced. Raise the life just enough to take the weight off the wheels, check the blocks and knee-action plates to determine whether the car is resting properly, and set the hand brake.

(6) Raising the Hoist

1. When the hoist is raised, use the safety leg, and check to see that safety catches are secured.
2. Never rock the car when the hoist is raised.
3. Raise and lower the object slowly. Do not try to rush the action of the hoist, as the gears may slip.
4. Do not attempt to raise a vehicle that may be heavier than the capacity of the hoist.
5. Except for cleaning purposes, never raise the hoist when it is not in use.

(7) *Self Protection During Work.* When working on raised objects, stand in such a position that your feet will not be crushed if the object should fall.

5. Working in Car Pits

1. Use only cleaning compounds in car pits; never use gasoline.

2. Do not place tools or derbis on pit steps, and always keep the steps free of oil and grease.
3. Arrange for proper lighting in the pits.
4. Keep the drain open.
5. Erect adequate safeguards around pits.
6. Do not allow unauthorized personnel in pits.
7. Keep guard chains for pits in place when the pits are not in use.

6. Charging Batteries

1. Beware of burns and shocks when charging batteries. Use rubber gloves when necessary.
2. Vent caps should be replaced before attaching or detaching charger cable; fumes arising from batteries in the recharging line are flammable.
3. Be sure that connections to batteries are properly made and secured.
4. Care shall be used in handling battery acids. When preparing electrolyte, the acid shall always be poured into the water.
7. **Welding.** See chapter 11 for specific precautions to be taken in welding operations.

8. Installing Tires

a. **REMOVING HUB CAP.** When removing a hub cap, hold one hand against the side of the cap so that it does not fly into your face when it is released.

b. **REMOVING TIRE.** When removing a tire from a wheel, turn the wheel until the valve stem is on the lower quarter; then pull the tire opposite the stem. This saves lifting the tire, which can be rolled off the wheel onto the ground. Such a procedure is particularly useful when changing truck or bus tires.

c. **CRACKED RIMS.** In replacing tires, take care that the rims are intact.

d. **LOCK RINGS.** See that the lock rings are properly installed. This should be done before the tire is fully inflated.

e. **INFLATING A TIRE.** Inspect a tire for defects and determine the proper pressure before inflating it. When inflating a tire, turn your face away from it; never hold it between your legs. Tires on wheels equipped with lock rings must be inflated in a safety cage when removed from the wheels. Tires on split wheels

must be deflated before removing the wheel from the vehicle and inflated after installing the wheel on the vehicle.

f. **INSTALLING TIRE ON WHEEL.** When putting a tire on a wheel, turn the wheel until the opening for the valve stem is on top. Then, resting the tire against the wheel with the stem on top, stoop, place a hand on each lower quarter of the tire, and lift it into place.

g. **SPLIT WHEELS.** All bolts on split or two piece wheels must be tightly secured before inflating tire. Tire must be deflated before loosening bolts.

04226 FUELING MOTOR VEHICLES

1. **Authorized Personnel.** Only authorized personnel shall be allowed to fuel motor vehicles, and they shall have a thorough knowledge of the hazards involved.

2. Care of Pumps

1. If the pump is electrically operated, be sure that the motor is shut off after the gasoline has been delivered.

2. Check at regular intervals for leaks at pipe connections, stuffing box, and meter. If leaks are found, do not attempt to repair them. Call a repairman, and keep the pumps out of service until the repairs have been made.

3. Have the base bolts secure at all times.

4. Do not attempt to make electrical repairs on pumps. Call a serviceman.

5. Automatic hose shutoff nozzles are not permitted unless constantly attended.

3. Using Fueling Equipment

a. **SPARKPROOF TOOLS.** Use only sparkproof tools when working on gasoline lines. Fuel tanks or containers shall never be welded, soldered, or repaired in the presence of an open flame until all trace of fuel and fuel vapors has been removed by steam cleaning or other approved method. Never strike a gasoline drum or barrel with a hammer or other metal objects; sparks, and subsequent fire, may result.

b. **EQUIPMENT MAINTENANCE.** Do not use leaky hose, pumps, valves, or faucets. Arrange for them to be repaired at once.

c. **GASOLINE CONTAINERS.** Gasoline shall not be left standing in unlabeled containers; metal

safety cans must always be used. If gasoline is to be carried away, it shall be done only when in the metal safety can, tightly capped, and suitably marked.

4. Fueling Procedure

a. **BONDING.** To prevent electrical static discharges, tank and hose shall be kept in metallic contact while gasoline is being poured into the fuel tanks. This rule applies to all kinds of motor vehicles, and especially to gasoline trucks.

b. **PROXIMITY TO ANTENNAS.** The fueling of motor vehicles in the proximity of antennas and antenna down leads should be avoided or conducted with special precaution. An ungrounded automobile, ungrounded filling nozzle, or merely the attendant's body in close proximity to transmitting antennas and down leads, may produce sparks sufficient to ignite gasoline vapor when the nozzle comes in contact with the tank opening. Pump nozzles must be grounded at all times, and motor vehicles, when fueling, must also be grounded before opening the tank.

c. **DANGER FROM FUMES.** To minimize the effects of gasoline fumes, the face should be turned away from the fuel pipes while making deliveries of gasoline. Always drain the nozzle before removing it from the tank of a vehicle.

d. **BATTERY TERMINALS.** If the gasoline tank is located under the seat, do not permit the nozzle to touch the battery terminals.

e. **DANGER OF OVERFILLING.** Take special care that fuel tanks are not filled to overflowing. This is particularly important in the case of motorcycles.

5. **Fire During Fueling.** If fire should break out in the fuel spout during fueling, remove the hose from the tank immediately and smother the fire with CO₂ extinguishers, dirt, sand, or a wet cloth (preferably chamois, if it is available).

6. After-fueling Procedures

a. **CAPS AND PLUGS.** Replace caps or plugs securely immediately after using drums or barrels containing gasoline. Caps and plugs should be in place when drums or barrels are empty, and these containers should be removed from the garage as soon as possible.

b. **PUMPS.** If the gasoline pump is the visible type, drain the gasoline from the bowl before closing the garage.

c. **MEASURING CANS.** Turn empty measuring cans bottom up and dry them thoroughly before storing them.

d. **PERSONAL HYGIENE.** After handling gasoline, mechanics should wash their hands thoroughly before eating. Clothing that has become soaked with gasoline should be changed immediately, to prevent possible burns and dermatitis of the skin. Gasoline-soaked rags should never be carried in the pockets.

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United States Navy
SAFETY PRECAUTIONS

Chapter 5
SEAMANSHIP

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Subsection A
GENERAL

05101 SAFETY FOR PERSONNEL

Safe practices in specific operations whether afloat or ashore will be found in the chapter applicable to the work or duties performed.

1. Safety Drills for Working Personnel. Proper supervision and the conducting of drills are vital to prevention of accidents and saving of lives. The following general precautions shall be taken:

1. The commanding officer shall make a study of the conduct of routine and emergency drills and shall note and eliminate any unsafe practices.
2. During boat drills crews launching lifeboats shall be supervised to decrease the hazard of anyone's slipping, falling, or being pushed overboard.
3. When conditions warrant, passengers shall be issued life jackets before embarking in a boat.

4. Life jackets shall be worn by boat crews during boat drills, when boat is hoisted or lowered over the side, when boats are operated in strong tides and adverse weather, and when manning the boats over the boat boom.

2. Swimming From the Ship. Swimming from the ship is allowed only when authorized by the commanding officer. A power boat shall be stationed as a lifeboat about 50 yards off the side of the ship from which swimming is being done. This boat carries a capable petty officer in charge, one man specially detailed to keep a watch on all men in the water, and a thoroughly capable swimmer as lifeguard. One man in the ship and one in the boat shall carry rifles to protect swimmers against such danger as sharks. The boat carries, and has ready for instant use, life jackets and ring buoy with line attached. Swimmers must remain between the lifeboat and the ship. Two petty officers shall be stationed on deck with life jackets and ring buoys to keep a watch on men in the water.

3. Passenger Safety (Civilian)

a. RESPONSIBILITIES OF SHIP'S PERSONNEL TOWARD PASSENGERS. In ships carrying passengers there is an added responsibility on the part of everyone to ensure their safety as well as the safety of working personnel. The following precautions shall be taken:

(1) *Stowage of Furniture.* Furniture is to be properly stowed and secured to prevent items such as chairs, tables, pianos, rugs, and deck chairs from getting adrift when the vessel rolls. This applies equally to baggage in state-rooms.

(2) *Installation of Guard Racks.* Guard racks shall be installed on tables, shelves, vanities, and other exposed areas during heavy weather to keep glassware from falling and breaking on deck.

(3) *Ladders.* Ladders shall be provided for the use of passengers getting into and out of upper berths. Nonslip coverings on safety treads shall be used on all stairways and ladders used by passengers.

(4) *Lifelines.* Lifelines shall be rigged on the promenade deck when necessary.

b. RESPONSIBILITIES OF PASSENGERS. Passengers shall be encouraged to cooperate in preventing accidents by following the safety rules below:

1. Report any unsafe condition observed.
2. Never move furniture which has been secured.
3. Never pass by or stand near open hatches while cargo is being loaded or discharged.
4. Never smoke in berths or beds.
5. Never wear high heels while playing deck games.
6. Never attempt to enter or leave an upper berth without using a ladder.
7. Never climb or descend stairways or ladders without using the handrails. Use handrails also while in the shower or bathtub.
8. Never try to close a port or replace a dead light without assistance when a vessel is rolling or pitching.
9. Never leave unsecured baggage in state-rooms.

10. Do not use the windward deck doors.

11. Passengers shall be assigned station number and location for emergency drills.

05102 SAFETY IN WORK AREAS

The following precautions relate to safety in working spaces insofar as general house-keeping and protective devices are concerned:

1. Use of Protective Devices

a. USE OF SAFETY TREADS. Nonslipping, non-corrosive safety treads shall be used around door coamings and at the foot of ladders and steps, and nonskid safety plates or other abrasive devices shall be installed adjacent to doorways and ladders where slippery conditions from wet decks may exist.

b. GUARDING WORK AREAS. Suitable guards shall be placed near all open hatches, cargo working areas, or other open spaces.

c. SECURING CHAIN RAILINGS. Stanchions supporting chain railings shall always be secured with toggle pins.

d. USING TOPPING LIFT STOPPERS. The ship should furnish a sufficient number of topping lift stoppers, where necessary, for safely shifting boom topping lifts.

2. Safety in Gangways and Passageways

1. All gangways and passageways shall be kept clean, clear, and well lighted. When decks, gangways, docks, or other passageways are slippery because of ice, oil, grease, or other material, the affected areas should be cleaned up at once or covered with sand, cinders, sawdust, or other antislip material.

2. No materials or obstructions shall be allowed in gangways or passageways.

3. Gangway stanchions shall be bolted or secured at the bottom with toggle pins to prevent the stanchions from being pulled out of their sockets.

4. Overcrowding of gangways shall not be permitted.

3. Safety in Using Ladders

1. Accommodation ladders shall be equipped with safe landing platforms and guardrails.

2. When ladders are used in a seaway, care

shall be taken to prevent fouling by small boats alongside.

3. When ladders are unshipped or roped off, care must be taken to ensure that dangerous access to the ladders is also roped off.
4. **Using Hatches and Doors Properly**
 1. Open hatches shall be provided with gratings or roped off to minimize danger to personnel.
 2. When hatches are open, care must be taken to ensure that they are secured open. The regular prop or catch provided shall be used. When work is being done through an opening of one section of a hatch, the remaining beams shall be pinned or locked to prevent their falling.
 3. Safety lines shall be rigged around the cargo hatch openings when cargo is not being worked. At such times hatch covers shall not be spread, since openings between the boards may cause accidents. Tarpaulins shall not be drawn across such openings unless the hatch boards are in place, except for temporary periods during inclement weather.
 4. Armored hatches fitted with balance weights and springs shall be inspected before closing to make certain that such fittings are properly installed and operative. No device that impairs the free functioning of the dogging-down mechanism may be used.
 5. Access through doors, scuttles, and hatches may never be blocked off without permission from the department head responsible for them. When permission is granted to block off an access, it must be done in such a way that free access can be regained in a minimum amount of time.
 6. Broken, split, or ill-fitting hatch boards must be discarded or repaired at once. All hatch boards and fore-and-aft and athwartship beams should, insofar as they are not interchangeable, be kept plainly marked to indicate the deck and hatch to which they belong and their position therein.
5. **Providing Proper Illumination.** Adequate

lights shall be provided during the night at all ladders, gangways, deck house entrances, and alleyways. These lights shall be rigged to avoid a direct glare. In addition, the following precautions shall be taken:

1. Personnel shall not be permitted to enter any unlighted cargo compartment unless a suitable portable light is carried.
2. Flash lights shall be kept available for emergency use.
3. Whenever cargo or ship's work is being performed at night floodlights shall be provided on the deck, overside, and in the cargo holds when the tactical situation permits.

6. **Entering Closed Compartments.** An element of danger exists whenever men must enter compartments that have been closed to all ventilation for a period of time. Occasionally the nature of the danger is known—that is, when there is an exact knowledge of the former contents of the space the hazards are known and the proper precautions can be taken. In many cases, there may be no reason to believe that hazards will exist. Even when there is no reason to fear danger, experience has shown that a very real hazard may exist. It is necessary, therefore, to assume that any closed space, blister, double bottom, tank, cofferdam, pontoon, or void contains gases with poisonous, asphyxiating, or explosive qualities. Where the hazard is known, personnel are referred to the appropriate chapter of *Safety Precautions* for steps to be taken. For example, refer to chapter 17 for hydrocarbon vapor hazards and to chapter 11, section 3 for welding in confined spaces. Where hazards are not known the following steps shall be taken:

a. **DETERMINING WHETHER FLAMMABLE OR EXPLOSIVE GASES ARE PRESENT.** First determine whether the atmosphere contains gases or vapor. Use a hydrocarbon vapor indicator for the test. If the test shows that explosive or flammable gases are present the compartment shall be treated according to the rules for the particular hazard.

b. **TESTING FOR CARBON MONOXIDE.** Aircraft carriers, battleships, and cruisers carry carbon monoxide indicators. In these ships the atmosphere shall be tested for carbon monoxide after

it has been determined (see paragraph a above) that no explosive vapors are present. If the carbon monoxide test is negative, a flame safety lamp shall be used to determine whether the oxygen in the atmosphere is sufficient to support life. The lamp shall be carried into the space by an observer who has a safety line attached to him and who maintains direct communication with a responsible person outside. If any dangerous condition is detected by the test (as disclosed by the action of the flame in the lamp) the observer shall come out immediately and ventilation shall be resumed. A satisfactory test must be made before personnel may stay in the area.

c. PROCEDURE WHEN THERE IS NO CARBON MONOXIDE INDICATOR. In ships not supplied with carbon monoxide indicators, ventilation shall be carried on immediately after step a above if it has been determined that no explosive vapors are present. The portable ventilator set shall be used, and the closed space shall be ventilated until there have been at least 2 complete changes of air. The flame safety lamp shall then be used, as described in paragraph b, to determine whether the oxygen content is sufficient to support life. If the test shows insufficient oxygen, ventilation shall be repeated until a satisfactory test is made.

d. PRECAUTIONS FOLLOWING SATISFACTORY TESTS. When air conditions are found to be satisfactory men may enter the spaces. However, the safety lamp must be kept operating at all times and direct communication with someone outside must be maintained. If the lamp at any time indicates dangerous conditions the men must withdraw immediately, ventilation must be resumed, and tests must again be made before work is resumed. Further, if the lamp indicates, or if it is observed in any way, that explosive gases may be present, the men must withdraw and reventilation and retesting must be carried out.

05103 DECK SAFETY

1. Lines

1. Lines shall never be made fast to capstans or gypsy heads.
2. If hawse pipe covers are not used, a safety

guard shall be installed forward of each hawse pipe to prevent personnel handling lines or on lookout from stepping or falling into the opening.

3. Personnel shall always stand clear of bights in a line.

2. Chain Lockers and Anchors

1. If a chain locker is not self-stowing, illumination shall be provided before personnel are sent to the locker.
2. Personnel in chain lockers engaged in tiering an anchor cable shall withdraw before any attempt is made to disconnect the windlass.
3. In letting go an anchor, windlass operators shall wear goggles when handling the brake.
4. Personnel shall stand clear of the windlass when heaving around or veering anchor.

3. Cranes, Capstans, Winches, and Windlasses.

Only personnel who have been instructed in the duties required and who have been specifically authorized by the first lieutenant shall operate cranes, capstans, winches, and windlasses. A list of authorized operators shall be kept in the gunnery (or deck) department office. Except in an emergency, operation of the machinery is supervised by a responsible officer or petty officer. The method of operation and necessary special instructions are posted at the place of operation. Safety guards shall be kept in place around windlass crossheads, cogwheels, or other moving parts.

4. Booms

1. Booms should be topped or lowered only under the supervision of experienced personnel.
2. Booms shall be lowered to the deck for changing gear or making necessary repairs.
3. For topping or lowering of booms the safest method is to secure the topping lift to the drum of the winch.
4. Booms shall be equipped with preventer guys.

5. Block and Tackle. Block and tackle shall be inspected before use for possible defects.

6. Life Buoys and Lifelines

1. When a ship is in port or when personnel

- are working over the side, life buoys with line attached shall be available.
2. Men are not permitted to sit or lean on the lifelines.
 3. In maneuvering alongside a dock or during drills or evolutions, personnel are required to keep well clear of lifelines.
 4. When lifelines are removed for an extended period, officers and petty officers concerned are required to ensure that emergency lines are rigged to protect personnel.
 5. At sea, men are not permitted to work over the side without life jackets with safety lines around them, properly tended by someone on deck. Men having occasion to work outside the lifelines, in rigging or unrigging gangways, or for other purposes, should wear life jackets.
 6. Ring buoys with a line attached shall be kept available for use when sea or Jacob's ladders are being used.
 7. **Bin Covers.** Bin covers shall be provided with safety latches or props, so that they will not fall on personnel.
 8. **Propellers.** Before permission is given the engine room to turn over a propeller, the following safety precautions shall be taken:
 1. Check all mooring lines and take in slack.
 2. Remove men working in the vicinity of the propeller.
 3. Maintain a bridge watch during the entire time the propeller is being turned over in order to stop the engine in case lines should part.
 9. **Smokestacks**
 1. Except in cases of emergency, personnel shall not be permitted to perform work on the smokestack when a ship is underway.
 2. In the event that work must be done, precaution shall be taken to prevent blowing tubes, lifting safeties, or blowing of the whistle.
 3. Boatswain chairs shall be used instead of swinging staging.
 4. A brass warning plate must be affixed in plain sight to all smokestacks cautioning personnel about the poisonous gases and fumes therein.

Subsection B

CARGO HANDLING

05111 INTRODUCTION

The safety regulations included in this section shall govern activity for all cargo handling. However, because of the special handling required for flammables and explosives (whether they are handled as cargo, for fuel, or for other purposes), they are treated separately in subsection c. All personnel handling cargo consisting of flammables or explosives shall be familiar with the regulations of subsection c and the references given there as well as with the following precautions.

05112 SAFETY FOR PERSONNEL DURING CARGO HANDLING

All personnel are required to board and leave ships by the gangplank or by other means

provided when cargo is being handled. Boarding or leaving a ship via cargo-handling gear or by climbing up or down a save-all, is prohibited. When ships' holds are equipped with stairways these must be used in lieu of ladders. Entering or leaving ships' holds by means of ships' cargo-hoisting gear is prohibited. In area where the handrails have been removed to make way for cargo, ropes must be used to block off the space to prevent personnel from falling overboard.

05113 PREPARING PIER AND CARGO GEAR

1. **Pier Inspections.** Pier flooring and structures should be inspected periodically. If defects are found, temporary repairs should be made immediately, and permanent repairs made as soon as possible. The pier must be in

proper condition when used during loading operations.

2. Preparation and Maintenance of Ship's Gear

a. PROPER USE OF GEAR AND TOOLS

1. Ship's cargo hoisting falls or whips shall not be used for mooring or shifting berths.
2. Cargo falls or ship's hoisting gear shall not be used to move railroad cars on piers.
3. Cargo booms should be tested and have their approved capacity plainly marked in a conspicuous manner and place, preferably at the heel of the boom.
4. Chains must be in good condition before they are used for sling loads. There shall be no kinks in chains, they shall never be shortened by wiring or tying, and repairs shall never be made even temporarily by bolting two links together or by the use of wire.
5. Blocks, crowbars, chain slings, and other equipment must not be thrown from the deck to the ship's hold or to the pier.

b. MAINTENANCE OF GEAR. Inspection of ship's cargo gear should be made by the ship's crew before the gear is used for stevedoring operations. The crew should give all assistance possible to keep ship's cargo gear in proper condition while it is in use.

c. RIGGING OF SHIP'S GEAR. See 09105 and 09122 for additional information concerning wire rope and rigging.

(1) *Winding the Winch Fall.* Whenever possible the winch fall should be so wound that the lever will have the same direction of operation as the load being handled.

(2) *Making Fast Boom Guys and Preventers.* The boom guys and preventers should be kept as far away from the heel of the boom as possible, but not past the line of the fall. They should be made fast in order to divide the strain. Preventers should be made fast around the head of the boom, independent of all other fastenings. Booms should always be topped so as to avoid undue strain on both the boom and the topping lift. Special caution should be used where the Samson or derrick post is low. The dragging of one fall against the other,

without plenty of sag, is positively dangerous and must be avoided.

(3) *Using an Additional Preventer.* When the location of winch controls is such that they expose a winch driver to the bight of the fall, an additional preventer should be placed on the lead block at the heel of the boom. The preventer should be not less than $\frac{5}{8}$ -inch wire cable and preferably $\frac{3}{4}$ -inch or larger. Land-yards must be attached to beam bridles and used when handling beams or pontoon hatch covers.

3. Inspection and Preparation of Stevedore Gear

a. SAVE-ALLS. Save-alls must be stretched, hung, safely secured to both vessel and dock, and in line with each hatch when general cargo is being worked.

b. REPORTING DEFECTIVE GEAR. If tools, materials, appliances, or other gear are at any time found to be out of repair, defective, or unsafe in any way, this condition should be reported immediately.

c. INSPECTING THE GEAR. Stevedoring gear must be carefully inspected by designated and competent personnel before being issued for use. Any unsafe or doubtful gear must be discarded, marked, and so placed that it cannot be used by longshoremen.

05114 LOADING AND DISCHARGING CARGO

1. Preparing the Hatch

a. CLEARING THE BEAMS. Only cargo which must be removed to clear the beams should be hoisted from the hatch until the hatch covers and strongbacks are off and stowed clear of working gear.

b. STOWING STRONGBACKS AND HATCH COVERS. Strongbacks and hatch covers should be stowed in such a way that they will not interfere with a safe walkway for hatch tenders from rail to hatch coaming and will not be tipped by drafts or cargo into the hatches or over ship's side. If a safe walkway cannot be provided, two hatch tenders should be used.

c. USING ONE SECTION OF HATCH. If just one section of the hatch is being used, the strongback of the adjacent section shall be bolted to the hatch coamings or otherwise secured or re-

moved before any cargo is worked through the section being used.

2. Moving the Cargo

a. GENERAL PROCEDURE

1. No cargo should be loaded or unloaded at any intermediate deck by a fall or sling unless the hatch at that deck is safely covered or a secure landing platform, of a width not less than that of one section of hatch cover, has been placed across the hatch.
2. Wooden decks on ships and lighters must be protected when working heavy or rough-edged cargo across them.
3. The gangwayman must not give the signal to hoist or lower any load unless it is properly slung and all the cargo secure, and no load shall be moved until the proper signal is given.
4. Loads shall be hoisted evenly. Slack on falls should not be taken up or loads let go suddenly.
5. Loads shall never be suspended over a square of hatch or a string piece but shall be stopped over the deck.
6. Loads shall be landed slowly and guide lines used when necessary.

b. HOISTING HEAVY WEIGHTS. When heavy weights are being hoisted or lowered aboard ship personnel supervising the operation are required to make sure that the gear used is of adequate strength and properly loaded. The following precautions shall be taken when heavy weights are moved:

1. A watch must be stationed below and the word "Stand Clear" given to men working or passing below.
2. Except where an emergency makes it impossible, the OOD shall detail a responsi-

ble petty officer to be present when boats, planes, and other heavy weights are hoisted.

c. HOISTING PALLETIZED LOADS. Palletized loads of packages of assorted sizes which are taken from piers for loading in ships shall be checked for safety before they are hoisted.

05115 STOWING AND BREAKING DOWN LOADS

1. Breaking Down Cargo. When it is necessary to break down cargo, it should be done from the tops of tiers, one tier at a time. Tiers should never be dug into or pulled down. Overhanging pieces of cargo left on a tier should be broken down to prevent their falling as a result of sudden shocks or jars.

2. Proper Tiering and Blocking

1. Cargo should be tiered evenly, tied in, stepped back, or floored off in order to prevent collapse.
2. Any object liable to roll or shift should be blocked in position.

3. Use of Dunnage. Sufficient dunnage should be used to keep general cargo from contact with the steel of a ship's internal structure (frames, stringers, coamings). In tiering, dunnage shall be used to provide a firm flooring.

4. Special Precautions for Deck Stowage

1. Where cargo is stowed on or in any deck above a lower hold it must be adequately secured to prevent it from falling into the hold.
2. Deck loads shall be so stowed as not to interfere with the safe operation of the winches. Care must be taken to prevent loose material from falling into the hatches or overboard.

Subsection C

HANDLING OF FLAMMABLES

05121 HAZARDS IN HANDLING FLAMMABLES

Toxic vapors and fire are the principal hazards in handling of flammables of all types. For a thorough understanding of the dangers involved personnel are referred to chapter 17 of *Safety Precautions* and to chapters 6, 15, and 92 of the *Bureau of Ships Manual*. Precautions for doing hot work in the vicinity of flammables are described in chapter 11, section 3 of this publication. The following additional hazards must be kept in mind:

1. **Bulk Handling of Gasoline.** Where gasoline is handled in bulk or as package goods the distance which ignition sources must be kept from possible leaks or spills is considerably increased because of the ease with which gasoline vapors travel. Care must be taken to keep these vapors from accumulating in low places or in confined spaces.

2. **Dangers From Fuel Oil and Diesel Oil.** Diesel and fuel oils are not especially irritating or harmful to the skin if exposure is not prolonged. Where fuel oil must be cleaned off it can be done primarily with a rag dampened with diesel oil. (*Never use gasoline.*) Any remainder can be removed with a liberal application of soap and water. Both fuel oil and diesel oil must be kept away from the mouth, and medical aid must be obtained if any is swallowed accidentally. Vapors can be particularly dangerous, and the precautions set forth in chapter 17 must be strictly followed.

3. **Special Dangers From Gasoline in Cold Climates.** In very cold climates the vapor-air mixture in the space above the gasoline in tanks may become explosive. This condition should be suspected whenever the liquid temperature drops below 20° F. In such cases all regular fire precautions shall be taken and work involving burning, cutting, welding, or any other hot work shall be done by permit only.

05122 PRECAUTIONS PRELIMINARY TO LOADING FLAMMABLES IN PORT**1. Care of the Wharf****a. CLEANING**

1. Any spilled oil on the wharf shall be immediately cleaned up. Sand may be used to absorb it.
2. All wharf risers shall be kept clean by wiping them with diesel fuel oil when necessary.

b. **WATCHING IDLE PIPELINES.** The expansion of products in idle pipelines as a result of heating is likely to develop excessive pressures. It is the duty of the wharf personnel to see that relief valves are installed and in order, to open manual relief valves when necessary, and to keep pressure gages on any filled but temporarily idle wharf lines, observing the gages at intervals.

2. **Care of the Ship.** Although chapter 17 emphasizes precautions to be taken against fire, the danger of destructive fire during loading is so great that additional warnings are necessary here.

a. **CARE OF CONTROLLED FIRES DURING LOADING.** The following precautions shall be taken to prevent liquid gasoline or gasoline vapors from reaching the engineering spaces while fires are burning:

1. The port captain or superintendent and the commanding officer of the ship must agree whether it is necessary to keep fires burning because of weather conditions, possible necessity of immediate departure, or other urgent reasons.
2. If there is no vapor-collecting system and the reason for lighting fires is to raise steam for departure, tanks aft of amidships should be topped off before the fires are lighted so that any spill will not release vapors near the engineering spaces.
3. While fires are burning, there should be enough room left in all tanks being loaded to eliminate any possibility of a spill.
4. If fires are to be lighted only to raise steam for the ship's departure, no changes in the ship's cargo control system should be made during the time they are burn-

ing, and no changes to shore lines or pumps which might increase the pumping rate should be allowed.

5. A watch should be stationed near the boiler room ventilators to observe such conditions as leaks, overflows, changes in wind, or evidence of vapor, and to order ventilators closed and fires out at the first evidence of danger.
6. A watch should stand by in the boiler room to execute instantly any order from the ventilator watch.
7. The foreman or superintendent and a ship's officer should patrol the ship personally, observe conditions, and check the rate at which tanks are filled.
8. If there is danger of possible enemy attack, it may become necessary to top off while gasoline is being loaded and to switch ship's lines and even draw samples without cutting fires.

b. PROHIBITING OPEN FLAMES. No fires, open flames, or open lights shall be allowed on the ship's deck, in the vicinity of vents, or in any compartment on, facing, or adjacent to that part of the deck on which cargo hose is to be connected. Proper warning signs shall be posted prohibiting open flames and smoking.

c. LIMITING REPAIRS. No repairs involving hot work shall be permitted.

d. AVOIDING DANGER FROM OTHER BOATS. Extreme care must be taken when tugs or other boats come alongside, as these may have open flames or fires.

e. AVOIDING DANGER FROM STACKS. Stacks of coal-burning tugs, dredges, pile drivers, and other coal-burning equipment should be fitted with spark arresters. Stacks must never be cleaned out when the vessel is lying at a fuel dock.

3. Care of the Area

a. DISPOSAL OF FLAMMABLE RUBBISH. Under no circumstances shall cigar or cigarette butts, pipe ashes, or matches (whether smoldering or extinguished) be thrown overboard or through portholes while a ship is moored to a fuel pier or is within the vicinity of such a berth. Such rubbish shall never be thrown from any enclosure on the wharf where smoking or fire is permitted.

b. ESTABLISHING A RESTRICTED AREA. When gasoline is handled, avoidable sources of ignition both in ship and on wharf will normally be eliminated within a distance determined by safety and good practice; this is usually at least 200 feet (or at least 50 feet in the case of flammables other than gasoline) from the ship, cargo hose, or any other possible source of flammable vapor or liquid. Such sources of ignition include not only fires, matches, and smoking, but also trolley cars, locomotives, power boats, electrical equipment not specifically approved for use in hazardous atmospheres, and all motor vehicles not equipped with proper safety devices. They also include such sources of static electricity as steam or air jets, spray painting and sand blasting, and all sources of heat and sparks apt to be involved in mechanical repair work or in the use of electrical equipment or radio transmission.

c. DISCONTINUING LOADING DURING STORMS. Except during an emergency the loading or discharging of flammables shall be discontinued during an electrical storm.

4. Special Precautions Preliminary to Loading Gasoline. Loading and discharging gasoline is, of course, more hazardous than the loading of fuel oil and diesel oil. When gasoline is loaded the following precautions shall be taken in addition to those in paragraphs 1, 2, and 3:

1. Adequate firefighting personnel and sentries must be posted during handling of gasoline.
2. Procedures and safety precautions must be coordinated between the ship and any other activity participating in the gasoline handling.
3. Limiting gasoline tank pressures must not be exceeded.
4. It is imperative that accurate records of the amount of gasoline in each of the ship's tanks be maintained at all times.

5. Preparing the Hoses

a. GROUNDING. Before the fuel hose is connected for transfer of fuel oil between ships and piers, each group of loading or discharging connections on the deck shall be well grounded by means of a copper cable to the connections on the pier, and this connection is maintained until after the fuel hoses are dis-

connected. In hooking up this grounded cable, the circuit is closed and opened at the shore end rather than at the ship end to avoid possible sparks in the vicinity of explosive fumes. A switch at the shore end of the cable is useful for this purpose. See also chapter 17, article 17252.

b. USE OF GASKETS AND FLANGED COUPLINGS. Gaskets shall be used in every hose joint. Where flanged couplings are used, a sufficient number of bolts is inserted to ensure a tight connection.

c. SUPPORTING THE HOSE. Hose is connected and supported in a manner that will prevent chafing. When hose is supported by ship's tackle the fall is made fast to some stationary point on the ship, such as a cleat or bitt.

d. USE OF DRIP PANS. Drip pans shall be hung under hose connections and expansion joints to catch drips and small spills.

05123 LOADING OF FLAMMABLES

1. Providing a Hose Watch

a. DURING DISCHARGE OF CARGO. When cargo is being discharged ashore, it is customary for the ship to provide a hose watch to stand by at all times to signal the pumper if an emergency occurs or if there is a signal from the wharf and to check the pressures on the gages attached to the wharf risers and ship connections.

b. DURING LOADING OF CARGO. When vessels are being loaded the depot should provide a hose watch to check for spills and leaks as well as to signal the pumper as outlined in paragraph a. The absence or dereliction of a hose watch constitutes one of the most dangerous violations of safety rules.

2. Safety During Loading

a. USE OF FIREFIGHTING EQUIPMENT. During the entire time that bulk or package cargo is being transferred at a fuel pier, the ship's fire hose should be connected to the ship's hydrants and let out ready for use in case of emergency. The ship's fire main should be connected to the shore fire main, if possible, when there is no steam or other power available in the ship. Before cargo transfer is started, other ship and dock or depot firefighting equipment shall be

placed where it will be ready for immediate use.

b. PRECAUTIONS AGAINST FIRES. In the loading of flammables, the following safety rules shall apply:

(1) *Avoiding Overheated Bearings.* Overheated bearings, glands, and stuffing boxes in tankers can cause serious fires and explosions in pump rooms. Frequent inspections shall be made while pumps are operating to see that bearings are kept well oiled and cool running.

(2) *Avoiding Sparking by Tools.* Hammering of dogs and nuts shall be avoided. If hammering is necessary, wooden mallets or other nonsparking tools should be used. If the cargo is gasoline, this is obligatory.

(3) *Preventing Oil Spills.* To prevent spills, all sea cocks and sea suction valves should be locked or lashed shut except when actually in use. Scuppers that would drain any oil spill into the water should be plugged. Tank tops should be kept closed during cargo transfer and clamped down unless local orders require that they be unclamped, and tanks should be closely watched for leaks. Ullage plugs should be kept closed when not in use and should be weighted or clamped down in accordance with the ship's regulations. Flame-arrester screens, if used, must be in good condition, whole and unclogged and snugly fitting the ullage plate. If spills should occur the following precautions shall be taken:

1. Oil spilled into the water should be cleaned up if possible, and any oil spill of consequence should be reported immediately to the commanding officer. The action to be taken may include warning vessels away, notifying downstream docks, calling the fire department to stand by, moving vessels from the dock, or (in quiet water) surrounding the oil with booms.
2. Gasoline spills should be watched closely and, if there is any suspicion of gas hazard, the surroundings should be tested for dangerous vapor concentrations.
3. If fuel oil accumulates on the adjacent beach or on the wharf structure it shall be cleaned up immediately. The hose watch and wharfmen should observe the

water at regular intervals for evidence of spilled oil; this is particularly important if fueling takes place at night.

(4) *Caution with Fire Main.* Pressure must be maintained on the fire main during fueling.

c. **STORES HANDLING DURING LOADING.** Stores may be handled direct to the poop deck during loading if the winch is driven by steam, air, or explosion-proof motor. In addition, any goods may be handled in emergency:

1. if there is a vapor-collecting system, or
2. if all tanks are kept closed and there is no escaping vapor on the side where stores are being handled.

Goods may be transferred during the *discharge* of gasoline cargo by permission of the responsible authorities. *In no case shall any ammunition, cargo, or stores be lifted over any hose which is in service and under pressure.*

3. **Over-all Loading.** Over-all loading (loading through an open hose directly into a tank hatch) is permitted only for fuel oil and diesel fuel oil. It is necessary in some cases and a time saver in others. During over-all loading the free end of the hose should always be lashed in position or otherwise firmly secured. Over-all loading should be strictly prohibited when any vapor hazard exists.

4. Additional Precautions for Night Loading

a. **FLOODLIGHTING.** Cargo transfer at night involves extra accidents and mistakes. In the absence of local regulations, night loading of gasoline should be accompanied with the greatest possible caution and should normally require thoroughly adequate vapor-proof floodlighting.

b. **SPECIAL PATROLS.** If leaks from pipelines might enter the harbor, railroad tracks, city streets, or buildings, or if the lines or valves are likely to be tampered with, one or more men should be assigned to patrol the shore pipelines. This patrol is in addition to the normal wharf and ship patrols.

c. **USE OF FLASHLIGHTS.** Personnel should be provided with approved safety flashlights or

electric lanterns, and these should be carried at all times while the work is in progress.

d. **TOPPING OFF TANKS.** Special precautions should be observed in topping off tanks, which should be done under the direct supervision of the ship's officer and the foreman and at a somewhat slower speed than that permitted by daylight.

05124 PRECAUTIONS AFTER LOADING OR DISCHARGING

1. Breaking Connections

1. Pans or buckets are placed under all hose connections before the connections are broken.
2. All hose is drained free of oil and washed out with salt water, if possible, after loading or discharging operations are completed.
3. Extreme care must be taken to see that no oil escapes from hose or pipelines into navigable waters. Hose ends shall be covered immediately with wooden plugs or with blank flanges and gaskets, secured by at least three bolts.

2. **Emptying Drip Pans.** Drip pans and tubs should be emptied as soon as possible, either by the use of a hand pump or by pouring the contents into a drum.

3. **Taking on Ballast.** Taking ballast aboard an empty ship from which a gasoline cargo has just been discharged causes an outflow of vapor from the tanks and involves an ignition hazard differing only in degree from the hazard of cargo loading. In one way the danger may be greater, as the tanks may contain an explosive mixture. Taking ballast aboard should, therefore, be prohibited while fires are lighted, unless it is urgent that the ship leave and the commandant and ship's commanding officer agree that it is unsafe to leave the dock without ballast. When ballast is absolutely necessary all the applicable precautions for the prevention of fire shall be taken.

Section 2

FIRE PREVENTION IN POWER BOATS

Subsection A General

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Subsection A

GENERAL

05201 FIRE HAZARDS

A fire is serious at any time, but in a gasoline or diesel-powered boat it has a more dangerous aspect. Boats are equipped with fire-fighting devices, but the best safeguard to those concerned with the handling of boats is an intelligent appreciation of the hazard and a knowledge of what causes it. This information may then be used to prevent conditions leading to a fire. Fires result from improper housecleaning on the boat, defects or leaks in machinery and equipment, and improper ventilation. Details of these hazards and precautions against them are discussed in this section.

As emphasized in section 1, gasoline engines of course present the greatest fire hazard. On various gasoline-powered craft such as aircraft rescue boats, plane personnel boats, line-handling boats, plane-rearming boats, etc. there exists the danger of explosion accompanied by fire. This may result from carburetor flooding, leaky gasoline lines, strainers, tanks, and flooding during fueling. Or explosion and fire may result simply from vapors, which in gasoline are so highly flammable that they can be ignited by sparks so minute as to be invisible to the eye. For an understanding of precautions against gasoline hazards personnel shall become thoroughly acquainted with the facts presented in chapter 17, section 2.

05202 QUALIFICATIONS FOR CREWS

In addition to being a qualified swimmer, as required by the *Bureau of Naval Personnel Manual*, each man assigned as a member of a power boat crew should have the following qualifications:

1. He shall have a thorough knowledge of safety precautions pertaining to the use and handling of gasoline and diesel fuel and the prevention of fires in power boats.
2. He shall have the ability to operate the type of fire extinguisher installed in the boat to which he is assigned.

05203 INSPECTIONS

A daily inspection of all power boats is made by an officer. This inspection is conducted in accordance with an approved check-off list by the designated officer. In port, this inspection is made during the morning watch or, in the case of boats that have been undergoing overhaul, before starting the engine. The coxswains and the engineers of the boats shall be present at these inspections. The results of the inspections shall be reported to the OOD, and the inspection form shall be turned in to the log room. In case a defect is noted of such a nature that operation of the boat violates safety regulations, a specific report is immediately made to the OOD, and the boat is taken out of commission until the defect has been corrected.

The inspection shall include the following:

1. **Electrical Connections.** Inspect to see that all electrical connections are in place and secured. Electric cable should be secured with clamps to prevent movement, since wear of the insulation through friction brings about the danger of short circuits.

2. **Fuel Piping and Tank Fittings.** Inspect fuel lines, strainers, tanks, and tank fittings for possible leaks and also for loosening of the tanks in the saddles. See that the filling connection is tight in the tank and that the filling cap is in place. Also see that any opening in the top of the fuel tank is tightly plugged. If plugs are loose, rolling or pitching may cause gasoline to spill over, or gasoline vapor may be forced out during filling operations. Remedy immediately all defects found to exist. The present standard tanks vent only through the filling pipes and in no case should tanks be so vented that gasoline vapor displaced during fueling operations can be trapped in enclosed spaces.

3. **Wire-gauze Screens.** Inspect to see that wire-gauze screens are intact and clean. On gasoline engines those over the carburetor and breather-pipe connections must be securely clamped so that they cannot be blown loose in case of a backfire or a crankcase explosion. Backfire screens shall be installed in accordance with the Bureau of Ship's latest instructions.

4. **Engine-space Bulkheads.** The forward and after engine-space bulkheads should be inspected for tightness in the bilges in order to prevent liquid and gas from passing over into the adjacent compartments.

5. **Carburetor Drip Pan (Gasoline Engines Only).** Drip pans are safe only when kept empty. Drip pans, therefore, should be inspected, emptied, and washed when the engine is stopped, at intervals while the boat is running, and before it is hoisted to its cradles.

6. **Bilges and Sumps.** These should be inspected before starting the engine and, if not dry and free from fuel vapor and oil, they should be pumped and dried out.

05204 HOUSEKEEPING AND VENTILATION

Good housekeeping in a power boat is essential for the protection of personnel and material and must be maintained at all times. The detailed daily inspection (article 05203) is indicative of the vast importance of the matter of cleanliness and good ventilation in all parts of the boat. Special attention shall be given to the following:

1. **Care of the Engine and Engine Room.** Improperly maintained engines and engine rooms present a number of hazards:

a. **CLOTHING AND WASTE MATERIALS.** The engine room must be kept clear of clothing, and cleaning rags and waste shall be kept in a closed container and burned after use.

b. **GASOLINE AS A CLEANER.** Because gasoline vapor is highly combustible when mixed with air the use of gasoline for cleaning the engine or any other part of the boat is prohibited.

c. **GREASE AND OIL ENCRUSTATIONS.** The greases and oils with which an engine becomes encrusted are a source of danger if not removed at regular intervals. These petroleum products will feed a fire, enabling it to get out of control rapidly.

2. **Washing Out the Bilges and Sumps.** Bilges and sumps shall be kept dry and shall be frequently washed out to clear them of fuel and oil. They shall be washed before hoisting into the boat skids. The space directly under the engine can be readily washed down by using hot water or a steam hose. This method will carry heavy oil and grease over into the sump, from which it can be pumped. Where engine-room bilges are filled with brass-covered balsam wood or cork, frequent inspections should be made to ensure that the brass is tight and that no fuel can be absorbed by the filling medium.

3. **Avoiding Combustion From Friction or Open Flames.** One of the essentials of good housekeeping in a small boat is to see that combustion cannot be brought about through carelessness with seemingly small items. As stated previously, there must be no smoking or naked lights in gasoline-engined powerboats. Further, only safety matches shall be allowed on board. This type of match must be struck on a prepared

surface before it will ignite. The ordinary kitchen type can be ignited by a sharp blow or by accidental contact with some object.

4. Proper Storage

a. **ANCHOR STORAGE.** Explosions and fires have occurred in cases where gasoline connections in motor launches have been broken by flukes while anchors were being removed from the gas tank compartments. The gas tank compartment is not intended for anchor storage, and because of the fire hazard involved it must not be used for this purpose.

b. **STORAGE OF LIFE JACKETS.** Life jackets have sometimes been stored in the gasoline tank compartments in motor launches. Although the hazard here is not great, the practice should be discontinued because of the fact that undetected leaks in the compartment can cause spills on the jackets. In addition, the jackets interfere with inspection in the compartments.

5. **Ventilation.** The presence of fuel in the bilges or in a free state in a boat is dangerous, since the fumes can be ignited easily. The free fuel may come from leaks in the fuel lines or units of the system or may result from filling the fuel tanks too full. Fuel may flow through the vent holes because of the motion of the boat, or it may run out because of the expansion of the liquid as it becomes warm. The fumes must be disposed of by proper ventilation. See articles 82-132 (f) and 82-117(10) of the *Bureau of Ships Manual*.

05205 CARE OF EQUIPMENT

1. **Firefighting Equipment.** Every boat crew shall be instructed in the care and use of firefighting equipment. Power boats carry portable or built-in CO₂ extinguishers, and the following precautions shall be taken in caring for them and using them:

a. **WEIGHING.** Portable and built-in CO₂ extinguisher cylinders shall be weighed at 3-month intervals. Quarterly weights of the extinguishers shall be noted on the cylinder record card provided by the manufacturer. If weighing shows that a cylinder has lost 10 percent of its rated capacity it must be refilled.

b. **INSPECTION AND REFILLING.** Instructions for inspection and refilling appear on a label plate furnished with the extinguisher. In built-

in systems this plate should be installed in the bulkhead in the vicinity of the cylinder or pull box.

c. **LEAKAGE.** Leakage can cause serious loss of capacity in a cylinder and go undetected unless cylinders are closely checked. Slow leakage often takes place under the sealing disk, or the sealing disk can be injured by inquisitive personnel and the resultant leakage not reported. Personnel shall be required to report accidental discharge of the contents of a cylinder so that the cylinder can be refilled as soon as possible.

2. Electrical Equipment

a. **WIRING IN THE BILGES PROHIBITED.** Electric wiring shall not be permitted in the bilges, and precautions against static sparks, short circuits, and sparks caused by striking steel with tools must be taken.

b. **WRAPPING EXPOSED TERMINALS.** All naked electric terminals shall be wrapped with insulating tape.

c. BATTERIES

(1) **Boxes.** The battery box shall be located outside a closed engine compartment and should be provided with a suitable drip-proof cover.

(2) **Battery Charging.** The charging of batteries will produce hydrogen gas which, if trapped and ignited, will result in an explosion. This applies particularly to motorboats having their batteries under the seats in the after part of the boat. If the battery is charged (other than from the boat engine generator) while in the boat, hydrogen may collect under the seats. If the hydrogen is not removed it can be ignited by a spark from the battery caused by a loose terminal or by the disconnecting of charging wires. Batteries should either be charged on deck or removed to an open space in the boat until the operation is completed.

3. Other Equipment

a. **THE EXHAUST PIPE.** The improper insulation of the exhaust pipe where it passes through the hull may set the boat afire. Elsewhere, a poorly insulated exhaust pipe may set fire to nearby objects or may ignite gas fumes if hot pipe is exposed to gas in the engine room. Poor insulation shall be corrected immediately.

b. **CARBURETOR DRIP PANS.** Carburetor drip pans are required to be installed in gasoline-

engined boats which are not fitted with approved type drip-proof carburetors. The only authorized pan is a type which can be removed without any of the contents being spilled into the bilges.

c. PORTABLE GASOLINE CONTAINERS. Portable gasoline containers shall be periodically inspected for leaks. If any leaky containers are found their contents shall be transferred immediately to a boat's tank or to a tight container, and leaky, defective gaskets and plugs shall be replaced. Water shall not ordinarily be introduced into a gasoline drum, but if a leaky container cannot be made tight by setting up on the filling and vent plugs, or if repairs are required involving the application of heat, the drum shall first be filled with water, emptied, and blown through with a steam or air jet to eliminate any vapor present. Repairs to gasoline drums or containers are not ordinarily required to be made by the ship's force, but are made at their distribution depots. Before a shipment of empty containers is made, the containers shall be carefully inspected to see

that they are tight and that all plugs are secured. Unless this is done, the containers constitute a fire hazard to the carrier.

d. WIRE GAUZE AND FILLING CONNECTION. The wire gauze in the filling connection is provided to prevent gasoline tank fires or explosions. It should never require removal. The dirt in the filling connection is usually scale and the connection itself can be backed out and replaced after being dumped. When replacing the filling connection, care should be taken that each part is set up tightly on its respective gasket.

05206 OVERHAUL AND REPAIR

Before any work is done inside the boat or on the hull or machinery, the bilges shall be thoroughly ventilated and cleared of any gasoline vapor present. All gasoline leaks, from whatever source, shall be stopped. When boats are to be repaired at a naval shipyard the fuel tanks shall be emptied and the bilges cleaned by the ship's force before the boats are sent to the shop.

Subsection B

FUELING POWER BOATS

05211 GENERAL PRECAUTIONS

1. Restrictions on Fueling. Under normal conditions gasoline powerboats shall not fuel unless in the water, with the engines stopped, clear of other boats and, where possible, near enough to the ship to receive aid if needed. Except in emergency, boats shall not be fueled at night. They shall *never* be fueled when passengers are aboard.

2. Proper Use of Fueling Equipment

a. PIPING

(1) *Ensuring Tight Seams.* Fuel piping shall be extra heavy, and the joints and seams must be kept tight. Shellac shall be used in making up joints.

(2) *Installing Cutout Valves.* Fuel feed lines shall in all cases be fitted with cutout valves installed near the fuel tank and shall be so fitted as to be readily accessible in an emergency. The cutout valves are to be fitted with

extension rods and operating handwheels and shall be so located that they may be controlled from the engine compartment.

b. GROUNDING HOSES. Grounding must be maintained throughout fueling and until the hose has been withdrawn and the filling flap closed. (See article 05122, paragraph 6.) The hose nozzle is provided with a grounding wire fitted at the end with a spring clip. Before the cover of the filling connection is unscrewed this clip should be clamped on the screen provided in the flange of the connection.

c. STRAINERS. It is preferable to insert the nozzle of the grounded hose directly into the filling opening. However, when the use of funnels is unavoidable the funnels shall be fitted with 40-mesh wire gauze strainers. The use of a chamois strainer is prohibited.

d. KEEPING THE TANKS CAPPED. Tank-fueling caps shall be kept in place when no fueling is being done.

3. Avoiding Open Flames. It has been emphasized in section 1, and cannot be overemphasized, that the great danger of fire during fueling calls for maximum precaution. No smoking and no naked lights (from oil lanterns, candles, matches, exposed electric switches, or slip rings or commutators of a dynamo) shall be permitted in the vicinity while fueling. There shall be absolutely no use of such lights in compartments containing gasoline engines or bilges or within 50 feet of gasoline storage tanks or gasoline vapor.

05212 FUELING PROCEDURE

1. Preparing to Fill the Tanks. The following precautions shall be taken *before* the filling pipe cap is unscrewed to ensure a maximum of safety during fueling:

1. Open the hinged covers fitted on the engine hood to permit a free circulation of air around the engine. Do not close these covers until fueling has been completed and the engine is operating satisfactorily.
2. Inspect the tanks and filling pipes. Do not fuel unless these are tight at all joints.
3. Close the cutoff valves at tanks.
4. See that the hatch in the coxwain's flat on motor launches fits snugly.
5. Close all openings (near the filling pipes) through which fuel vapor might pass into closed compartments.
6. Ground the hose, as described in article 05201, paragraph 2b. In the 26-foot motor whaleboats, where no screw is provided, clip the grounding wire to the 1/4-inch copper gooseneck vent pipe fitted on the tank. The grounding screw is not required to be fitted in diesel-engined boats.
7. Keep one member of the boat crew standing by with a portable CO₂ fire extinguisher ready for use. The extinguisher is not to be returned to stowage position until fueling is completed and the engine is operating satisfactorily.

2. Filling the Tanks. When all the above operations and the related precautions have been carried out, the following steps shall be taken in filling the tanks:

1. In standard tanks the filling pipe is the only opening provided for escape of vapor which is forced out the tank during fueling. Therefore care should be taken not to push the nozzle so far into the filling pipe that it will choke the opening and thus prevent the escape of the displaced vapor.
2. If for any reason the hose nozzle is withdrawn during fueling and the ground wire becomes detached, the ground wire must be reattached to the screw before the nozzle is again inserted in the filling pipe (not required on diesel boats).
3. The nozzle trigger shall be kept under control so that fuel will pass through the filling pipe strainer and so that overflowing can be avoided by reducing the flow when the tank is nearly full.
3. **Procedure After Filling Tanks.** If any fuel has been spilled, wash down and wipe dry.

05213 FUELING IN SPECIAL SITUATIONS

When fueling from shore stations, by portable containers, or while a boat is in skids, all the above precautions shall be taken when applicable to the situation. In addition, all precautions set forth in this article shall apply.

1. Fueling From Shore Stations. Serious fires have occurred during fueling from shore stations when proper grounding connections were not made. Before permitting a gasoline-engined boat to fuel from a shore station, an inspection of such station should be made by the officer or petty officer in charge of the powerboat to see that grounding connections are provided by either the boat or the station. These grounding connections should be of wire or solid metal, and care should be taken to see that the contacts are positive. Wrapping wire around the metal parts of the filling hose or using chains is not sufficient.

2. Transfer by Portable Container. Gasoline shall not be transferred to a boat from a drum or other portable container unless the container has been isolated from other containers. An exception to this rule is a vessel whose drums are stowed in quick-releasing racks, in which case the drum shall be left in its rack during fueling. An adapter shall be provided with a

standard iron pipe-size screw thread on one end to fit the opening in a standard gasoline drum; the other end should be fitted with a Navy standard hose thread, to take a standard 1¼-inch inside diameter flexible metallic hose covered with rubber and fabric. This hose will be furnished in 25-foot lengths having couplings and nozzles with Navy standard threads. The standard gasoline-filling hose nozzle is of the "wet hose" type, which will release gasoline only when the operating lever is gripped and will automatically cut off the flow when the lever is released. This instantaneous control prevents overfilling of tanks. Overflow of the tank should be carefully avoided, especially on boats where the filling fitting is located in-board. However, in decked-over boats and motor launches the filling fitting is located on deck. Therefore overflowing gasoline will pass overboard and not into the bilges.

3. Fueling When a Boat Is in the Skids. In an emergency it is sometimes necessary to fuel a boat in the skids. For detailed precautions in such a situation see the *Bureau of Ships Manual*, chapter 82, paragraph 117(9). In addition, the following precautions shall be taken:

1. Adequate firefighting equipment shall be provided at the scene.
2. The fire main shall be under suitable pressure and hose led out to the scene from at least two fire plugs.
3. If practicable a metal hose, thoroughly grounded to the supply tank or drum and to the boat's tanks, should be used for transferring gasoline.
4. Where the use of a metallic hose is not practicable and a separate container must be used to pour gasoline into the boat's tanks, this container, the boat's tanks, and the supply tank or drum should be interconnected by a flexible conducting wire of adequate length. Portable containers shall

be inspected after emptying to insure that all gasoline has been drawn off and shall then be closed tightly by setting up on the filling and vent plugs.

05214 STARTING THE ENGINE AFTER FUELING

Before starting an engine after fueling, or before starting when the engine has been idle for a day or more, every precaution must be taken to ensure thorough ventilation. The same precautions shall be taken if gasoline vapor is noticed when the boat is under way. Gasoline fires have occurred through ignition by sparks from some part of the electrical equipment while the engine was turning over; therefore it is necessary to the safety of both personnel and material to stop the boat and clear out the gasoline vapor before continuing to run the engine. The following precautions shall be taken:

1. Fire extinguishing equipment shall be readily available, and a crew member shall be standing by ready to operate it if necessary.
2. If door or hatch openings are inadequate to supply sufficient ventilation, air circulation may be induced by fanning or using an air bellows.
3. Fuel lines shall be inspected for leaks and any that are found shall be corrected immediately.
4. The engine must be inspected for loose electrical connections, bare terminals, and damaged insulation. If any of these are found they must be reported to the boat electrician.
5. If gasoline has been spilled into the bilges during fueling the bilges shall be washed down, pumped, wiped out, and aired thoroughly before the engine is started.

Section 3

UNDERWATER OPERATIONS

Subsection A Submarines

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Subsection A

SUBMARINES

05301 PREPARATION FOR UNDERWATER WORK

1. Hazards. In underwater work involving diving or making ascents from any depth with a respiratory apparatus such as a diving suit or lung, the users of such devices are subject to abnormal conditions which, under certain circumstances, have long been recognized to be hazardous; hence proper precautions are necessary. Air embolisms and bends are the greatest hazards met in underwater work, and conditions causing them, in addition to precautions against them, follow:

a. BENDS

(1) Cause. When compressed normal air, consisting of approximately 20 percent oxygen and 80 percent nitrogen, is breathed, the nitrogen is taken up in solution by the blood and tissues of the body. When the pressure is reduced the nitrogen is released by the tissues and blood in a gaseous state. If the release is sudden, the large bubbles formed collect around the ligaments, joints, and muscles and cause what is known as bends.

(2) Prevention. To prevent bends it is essential that the release of pressure beyond a certain stage be gradual. In diving work this is accomplished by requiring the diver, after he has ascended part way to the surface, to stop for proper desaturation at various stages and for certain periods throughout the remainder of the ascent.

b. AIR EMBOLISM. In ordinary diving work the possibility of air embolism in the diver is remote, as he is always hoisted to the surface at a proper rate. In individual escape from submarines, however, and in lung training, the possibility is greater. It could and probably would occur:

1. through a too rapid ascent,
2. by the subject, through fear or other cause, holding his breath during ascent,
3. by defective apparatus interfering with adequate breathing.

2. Training of Personnel. The prevention of bends and air embolism is dependent upon the physical fitness of personnel, the satisfactory functioning of the escape apparatus, and the proper decompression and gradual release of the intrapulmonic pressure in the body. Proper decompression and gradual release are the major objectives, and they can be attained by well regulated ascents. To assure proper methods, all personnel shall be well trained in use of the lung and shall fulfill the following requirements:

a. REQUIREMENTS OF INSTRUCTORS. Instructions should be given only by personnel trained and qualified in the use of the lung. An officer thoroughly familiar with the use of the lung and with training procedure should always be present when training is in progress. When escape training is under way, the officer in charge (or a qualified chief petty officer detailed by the

officer in charge), together with a medical officer, should be at the top of the tank or point of emergence from the water, and an officer or qualified chief petty officer should be in the lock or submarine compartment from which the escape is made; also, a medical officer should be in attendance when the recompression chamber is being used.

b. PHYSICAL FITNESS REQUIREMENT. All candidates for training shall be physically qualified in accordance with the Bureau of Medicine and Surgery requirements. See chapter 94, article 107 of the *Bureau of Ships Manual*.

c. NEED FOR FAMILIARITY WITH EQUIPMENT. Candidates shall understand thoroughly the operating principle of the lung and the function of each of its constituent parts before being permitted to wear it when submerged.

d. PREPARATION FOR PRACTICE ASCENTS

(1) *Inspection of Lung.* No candidate for submarine training shall be permitted to use the lung until the instructor in charge has examined it, found that it functions satisfactorily and, in particular, that its essential parts are properly assembled and in good condition, as follows:

1. The rubber mouthpiece must contain both rubber lugs.
2. The mica disc valves in the metal housing, which govern the directional flow of inhalations and exhalations, must be in satisfactory working order, as evidenced by a pronounced clicking of the valves during inhaling and exhaling.
3. The canister (filler) plug and the combination canister and respirator cap must be secured watertight.
4. The canister wire mesh internal screens shall be free of soda lime.
5. The rubber relief valve must be intact and functioning properly, releasing excess oxygen with the bag submerged and the top awash.

(2) *Checking Proper Breathing.* Before permitting the diver to submerge, the instructor should take every precaution to ensure that the candidate inhales from and exhales into the lung properly. This may be done by having the man submerge just below the

surface of the water, where a check can be made to see that the lung is being used correctly, that the breathing bag is inflated with oxygen, that the nose clip seals the nostrils, that the mouthpiece is properly gripped by the teeth, and that the diver is breathing slowly and deeply. Candidates should not be permitted to descend to depths in excess of 7 feet (measured from surface to their feet; the head should not descend more than about 1 foot below the surface) with a lung which has been inflated at the surface. In all cases of escape, the instructor should have each man put on his lung just before leaving the lock, compartment, or bell, and take a few breaths as a final check on whether the apparatus is functioning properly and with the mouthpiece valve open. At this time, too, any soda lime dust that is drawn through the mouthpiece may be expelled from the mouth and lungs before the man enters the water.

e. MAKING PRACTICE ASCENTS. The following safety precautions should be observed when practicing qualifying ascents from the 12-, 18-, 50-, and 100-foot levels.

(1) *Ascents from Levels up to 12 Feet.* The first ascent shall be from a depth not greater than 12 feet, and the following requirements shall be fulfilled:

1. Before completion of training at this depth the man under instruction shall be required to make at least one stop, for a period of about 30 breaths or 2 minutes, to ensure his proper breathing into the lung. He shall be cautioned against the tendency to let go of the line after taking 30 breaths.
2. Men shall be instructed, in leaving the bell, to reach outside and grasp the line with the right hand, place the left hand against the inside of the bell, duck under the skirt, turn and face the line, and then slide up until the feet can be placed on either side of the line. The body should be fairly erect, the two hands grasping the line at about waist level. The pressure exerted on the line by the hands and knees should be such as to allow the line to slide between them at the rate of about 50 feet per minute.

3. If, on leaving the bell, the bag is accidentally squeezed, the men should be cautioned to return if possible; otherwise, they should continue the ascent slowly, exhaling and inhaling normally. The action of ascending will automatically inflate the bag.
4. If anything unusual occurs during ascent, such as losing the mouthpiece from the mouth, the ascent can be made from this depth without a lung if the expanding air in the man's own lungs is released by exhalation.
5. If the buoy line is lost the diver should attempt to retard his rate of ascent by any means possible, and should exhale forcibly.

(2) *Ascents From the 18-foot Level.* At least three ascents from this depth are mandatory. The first ascent shall be made with a stop for decompression in accordance with the standard decompression table. The subsequent ascents shall be made without stops, at a speed of about 50 feet per minute. Careful training and instruction in judging this speed is essential.

(3) *Ascents From 50- and 100-foot Depths.* These ascents are voluntary. They are limited to trainees who have just previously qualified in ascents from the 18-foot level. For full information regarding such ascents, see the *Bureau of Ships Manual*, chapter 94, article 101.

05302 RESCUE WORK IN DISABLED SUBMARINES

1. **Accepted Methods of Rescue.** The current accepted methods of rescuing personnel from a sunken submarine are:

1. employment of the rescue chamber;
2. individual escapes by the submarine crew through use of escape apparatus (the lung) or by free ascent;
3. bringing the submarine to the surface by blowing ballast tanks and unwatering compartments.

2. **Conditions Affecting Rescue.** Before the crew members in the rescue chamber open the submarine hatch, they must be prepared for many conditions inside. Only two of these con-

ditions will be mentioned here. Each occasion presents different problems and the judgment of the operators must determine their actions under the various emergencies.

a. **PRESENCE OF SEA PRESSURE.** If the submarine compartment is punctured sea pressure will exist inside, with the men breathing in the air space above the water. This condition will make itself apparent to the chamber crew by air escaping around the edge of the hatch as the latter is cracked. Under these circumstances the hatch must be closed again, a pressure equal to the sea pressure outside must be built up in the chamber, and the hatch then reopened. After the passengers have been removed and taken into the chamber and the submarine hatch has been closed, the pressure must be vented through the upper compartment vent before the chamber is unsealed from the submarine. Proper decompression must be used in the venting.

b. **PRESENCE OF CHLORINE OR CARBON DIOXIDE.** When a submarine compartment contains chlorine gas or carbon dioxide, the crew must use lungs as respirators.

05303 PREPARING FOR INDIVIDUAL ESCAPE

1. Preparation of Equipment

a. **ASSEMBLING TOOLS NECESSARY FOR ESCAPE.** All available electric lanterns and flashlights, wrenches suitable for all nuts which must be removed, a maul or sledge for breaking sea connections, and a pinch bar shall be assembled and stowed in the escape compartment.

b. **SECURING THE TELESCOPIC SKIRT.** If an escape compartment is not fitted with an escape trunk, the telescopic skirt at the escape hatch must be in position and secured. See chapter 94, article 33 of the *Bureau of Ships Manual*.

c. **CHECKING THE OXYGEN SUPPLY AND EQUIPMENT.** The oxygen supply and equipment must be checked. If the oxygen cylinder for inflating the lungs is not completely charged and the contents is not sufficient for inflating every lung, a spare cylinder should be made ready for use. A check should be made to see that the reducer on the cylinders is set at 60 p. s. i., that all valves in the oxygen manifold are open, and that oxygen is available at the charging chucks.

d. **ESCAPE BUOY.** An escape buoy and buoy line should be ready and free for running.

2. Preparation of the Area

a. **SECURING THE BULKHEAD.** The bulkhead must be secured for watertightness.

b. **REMOVAL OF THE STRONGBACK.** The hatch cover must be locked and the strongback, if fitted, removed.

c. **SECURING THE HATCH.** A light line (the end of the buoy line may be used) should be secured to the hatch cover as a preventer, to keep the cover from flying open while flooding.

d. **PURIFYING THE AIR.** Before flooding the after torpedo room or forward escape trunk, carbon dioxide (CO_2) absorbent should be used as prescribed for submarine air purification. This will keep down the CO_2 content during preparations for flooding. However, this absorbent affords no protection against chlorine, and its efficiency is dependent upon its remaining dry.

3. Precautions for Personnel

a. **REMOVAL OF CLOTHING.** Men should remove their shoes and coats, but not socks, trousers, or shirts, preparatory to donning the lung.

b. **DONNING THE LUNG.** Each man should put on his lung, following the procedure outlined in chapter 94, article 5 of the *Bureau of Ships Manual*, checking to see that the lung is in good condition, that the canister is full of soda lime, that there is no obstruction to inhalation and exhalation through the mouthpiece, and that the flutter relief valve on the bottom of the breathing bag is flexible and in working order.

4. Flooding

a. CONSERVING OXYGEN WHILE FLOODING

1. While preparing for and during the process of flooding, all occupants of the compartments not engaged in the work should remain at rest, thus contributing to oxygen conservation and to keeping the production of carbon dioxide at a minimum. If the submarine has been submerged for several hours the combined effect of pressure and CO_2 already present or built up may become dangerous.

2. Oxygen charging hoses shall be used during flooding, and their length in the trunk shall be such that they will not hang out-

side the door or be pushed up behind the hinges.

b. **USE OF COMPRESSED AIR.** The air pocket formed in the escape trunk after flooding is comparatively small, and unless compressed air is available and has been used continuously to keep down the water level, breathing for extended periods without the lung will probably increase the CO_2 content to dangerous proportions. If compressed air is used, the excess air and its escape below the upper sill of the door (if fitted) will dilute the CO_2 in the pocket sufficiently to keep the air respirable.

c. PRECAUTIONS AGAINST EXCESS CO_2

(1) *Evidence of CO_2 .* If, while flooding of an escape trunk or compartment is in progress, there are symptoms of excess CO_2 , the occupants should immediately start breathing through the lung. Excess CO_2 , if breathed, will be evidenced by increased respiration—the breathing will become fast and there may be a tendency to gasp, possibly accompanied by growing dizziness.

(2) *Using the Lung as Respirator.* To use the lung as a respirator, remove the combination canister and respirator cap, piece No. 7 shown in figure 94-1 of *Bureau of Ships Manual*, and put on the lung as for escape. Under these conditions the surrounding air is drawn through the canister and respirator cap connection to the inside of the bag, from which it is drawn up through the bottom of the canister and purified before entering the wearer's mouth. Be sure, however, that the cap is replaced tightly before inflating the apparatus with oxygen and using it for escape.

05304 EMERGING FROM AN ESCAPE COMPARTMENT

1. Preparatory Steps

a. **RELEASING THE BUOY.** When flooding has been completed and the buoy passed up through the hatch skirt—with the line allowed to run until the buoy watches—care should be taken to ensure that the bitter end of the buoy line has been secured in the compartment before the

buoy is released; otherwise the buoy and line may be lost. After the buoy reaches the surface, the buoy line should be secured in the compartment to keep the line taut during ascent of the crew.

b. CHARGING THE LUNGS. There are four outlets to the oxygen manifold, and four lungs can be charged simultaneously. Charging should be completed rapidly and continuously so that individual emergence can be effected at about 1-minute intervals.

2. Ascending. After charging the lungs, the occupants of the compartment duck under the hatch skirt, follow the ascending line through the hatch, and ascend one after another, slowly and at a uniform rate, until they reach the surface.

(1) Use of the Ascending Line. Passage through the hatch should be made cautiously in order to avoid fouling projections and possible deck wreckage. As the feet clear the hatch, place the ascending line between the feet or bend one leg around the line and ascend at the rate of about 50 feet per minute. This rate will be approximately attained if the ascent is made slowly and hand over hand.

(2) Importance of Upright Position. The reason for placing the ascending line between the feet or bending a leg around it during the ascent is that it not only slows up the ascent but assists the man in keeping his feet down. The feet must not be permitted to float out so that the body assumes a horizontal position, or a position in which the rubber relief valve is above the level of the top of the breathing bag because the oxygen in the breathing bag will be pressed out and lost. Since under such conditions the bag will be automatically reinflated when the man gains an upright position and continues his ascent, the mixture in the reinflated bag will not be as rich in oxygen.

(3) Importance of Slow Ascent. If the sea is rough, the rise and fall of the waves may cause some discomfort when shallow depths are reached in the ascent. Even under these conditions, however, the ascent must be made slowly.

3. Surfacing. After reaching the surface, keep the mouthpiece in the mouth and close the rubber relief valve by folding it over and clamping it with the right-hand trouser clamp.

Note whether the breathing bag is fully inflated and, if so, close the cut-off valve in the metal housing and remove the mouthpiece from the mouth. If the bag is not fully inflated, fill it completely by exhaling forcibly into it, then close the cut-off valves. The apparatus will now support the wearer on the surface. The breathing bag should not be allowed to become deflated; this can be avoided by forcibly exhaling into it when necessary.

4. Maintaining Contact. If it is necessary for the crew to remain in the water for some time it is desirable that crew members remain in contact with each other. No special equipment is furnished, but a line improvised from the men's clothing will help in maintaining contact and in providing any assistance that may be needed by weakened members of the crew.

05305 EMERGING FROM AN ESCAPE TRUNK

1. Use of the Access Trunk. The escape trunks are usually fitted with a door and equipped for use during escape. The escape procedure is essentially the same as that governing escape from a compartment (after torpedo room). See chapter 94, articles 45 to 48 inclusive of the *Bureau of Ships Manual*.

2. Clearing Debris Near the Trunk Door. If there should be any obstruction outside the trunk door it should be cleared away by the first group emerging from the trunk. If possible, this should be done before the men ascend to the surface. It may be necessary to return to the trunk, and thence to the compartment, to obtain gear to do this. While the lung was not designed as a diving apparatus, it will, with a full initial charge, permit normal respiration for five or six minutes at any depth not exceeding that at which it was initially inflated. If necessary a man can work for about five minutes at a time outside the trunk and then return to it, recharge his lung, reemerge, and continue to work. Under such conditions, however, it is absolutely essential that he hold himself down to the deck,

since he will otherwise float too rapidly to the surface. If such work has to be undertaken the man should be provided with a short improvised lifeline secured to the outside of the

trunk. When the work is completed this line should be removed and stowed away to ensure that it does not foul the door and prevent its closing.

Subsection B

DIVING

05321 REQUIREMENTS FOR DIVERS

1. All divers must have the physical examination outlined in the manual of the Bureau of Medicine and Surgery.
2. A diver must be proved to be fully qualified (including physical examination and training) before he is put down.
3. Except in case of an emergency or to requalify a diver under adequate supervision, personnel whose qualifications have lapsed shall not be sent down.
4. Divers must be properly schooled in the operation of the type of diving outfit they are to wear.
5. Divers must know the diving hand signals.
6. Divers shall consume no alcohol during the 24 hours before diving operations begin.
7. Personnel suffering from severe colds, sinus or ear trouble, or acute illness shall not be allowed to participate in diving operations.
8. Personnel subject to fatigue from loss of sleep or previous severe physical or emotional strain shall not participate in diving operations.

05322 DIVING EQUIPMENT

1. **Essential Gear.** Diving lockers shall contain the following equipment:

1. Location and search gear adequate to properly search a given area, including buoys and anchors for marking such areas.
2. Adequate and safe diving equipment for two divers.

2. Care of Equipment

a. PERSONAL EQUIPMENT

1. All equipment must be maintained in first-class operating condition.

2. The control, nonreturn, and regulating escape valves should be inspected frequently and must operate satisfactorily at all times.
3. The leather items shall be checked and shall be oiled when necessary to prevent deterioration.
4. The helmet fittings—safety lock, windows, goosenecks, air passages, and gas-kets—should be securely in place and free of all obstructions and verdigris.
5. The diver's air compressor must be properly lubricated, cooled, and cleaned, both during use and while in storage. If the compressor is not used it should be broken out every 30 days, run, and again prepared for storage.

b. THE RECOMPRESSION CHAMBER

1. The recompression chamber must be ready for use at all times.
2. All possible flammable material shall be removed from the chamber.
3. Only fire-retarding paint shall be used in the chamber.
4. No open flames—matches, cigarette lighters, lighted cigarettes or cigars—shall be taken into the compression chamber while it is in use.
5. Neither the fan nor the heater is to be used during or immediately after the use of oxygen.
6. Decompression and treatment tables shall be located on both the inside and the outside of the chamber. The tables shall be strictly adhered to, and there shall be no deviation from them except in rare cases where the time element may outweigh all other considerations.

**05323 PREPARING FOR
DIVING OPERATIONS**

Foresight used in the sound planning of a diving or salvage operation is half the job. Emphasis is too often laid on the emergency of the work, resulting in men and equipment arriving at the scene of operations unprepared. Often, too, inexperienced diving supervisors, impelled with the urge to do something, put a diver over on the long chance that he will stumble onto the object. All available equipment is to be used for a search and a diver sent down only when other methods have failed. To repeat, planning is paramount if systematic locating operations are to be undertaken from the surface and, in most cases, this approach is easier, faster, and more accurate than that of the diver with his circling line. When a diver must be used, the following preparation shall be made:

1. Personnel Involved

a. PLACING A QUALIFIED OFFICER IN CHARGE. No diving operation should be started without the presence of an officer qualified in diving. If, however, such an officer is not available, a qualified diver should be placed in charge.

b. ARRANGING FOR RELIEF. A diver should never be sent down unless a relief diver is available and unless both divers can be maintained on the bottom for a reasonable length of time.

2. Using the Decompression Table. A decompression table shall always be at hand when diving operations are undertaken. When decompression is contemplated a stage should be rigged and the stage line marked at 10-foot intervals. A diver should never be allowed to descend without first determining his decompression time for his expected stay on the bottom.

3. Taking Soundings. When planning diving operations, no reliance should be placed on charts or hearsay as to the depth of the water; instead, a qualified man should take soundings with a lead line. If an area is being searched, soundings should be repeated from time to time.

4. Briefing the Diver. Sketches, blueprints, or other graphic devices shall be used in addition to regular briefing to train the diver in the work he is to do while on the bottom.

5. Final Check of Equipment. Never allow a diver to descend without making a final check to see that:

1. the helmet is tightened securely and the helmet lock locked in place,
2. the air hose and lifeline are securely tied to the breastplate,
3. the exhaust valve is set,
4. the control valve is open and air is passing through the suit,
5. the diver makes a sound test of the non-return valve seating,
6. the jock-strap is tightened properly,
7. the face plate is securely closed,
8. the diver has a ready, pure, and adequate supply of air at the proper over-bottom pressure and this pressure is maintained,
9. the descending line is properly placed,
10. telephone communications are in good order,
11. and, finally, the diver has given his signal to descend.

6. Instructions for the Diver. In order to work efficiently and safely underwater, a diver must keep in mind the following points:

a. PROPER USE OF DIVING GEAR

1. The air control valve should never be completely closed except when there is a rupture or when the air hose is being replaced.
2. The helmet air-regulating exhaust valve stem, known as the chin valve, may be used effectively to quickly release the suit pressure when the diver wishes to stoop or crawl on the bottom without changing the air-control valve and the air-regulating exhaust valve adjustment.
3. The helmet spitcock offers another method of relieving excess pressure in the helmet.
4. The safety nonreturn valve in the helmet gooseneck and the helmet air-regulating exhaust valve will seat themselves if the diver's air supply is impaired, but the spitcock, if open, must be closed immediately by hand.
5. A diver is never in danger from a leaking dress if he remains in an upright position.

b. EMERGENCY MEASURES TO BE REMEMBERED

(1) If Air is Cut Off. Air trapped in the

diving helmet will last from six to nine minutes for breathing purposes after the diving air is cut off, thus providing ample time for emergency measures to be taken if the diver does not get excited.

(2) *If Fouling Occurs*

1. If a diver discovers that he is fouled he should remain calm and attempt to extricate himself by slow, methodical steps. The distance line should *never* be released, as it is a safe guide and should show the way out of a tangle. The diver should instruct the surface crew to take up slowly the slack in his air hose and lifeline. Only after resting and again trying unsuccessfully to free himself should he ask for help.
2. In the event that a diver is fouled and cannot extricate himself the relief diver who is sent down must be prepared to replace both air hose and lifeline—a procedure that may be safely executed on the bottom.

05324 SAFETY DURING DIVING OPERATIONS

1. Precautions Preliminary to Dive

1. Never use a hand pump without knowing its efficiency. If the efficiency has dropped too low, the pump must be overhauled.
2. Never attempt any diving operation if the compressor is not operating satisfactorily or gives any indication that it will not continue to so operate.
3. Never connect the air hose directly to the delivery nozzle of a diving compressor or diving pump which requires an oil separator or volume tank.
4. Never belay a diver's lifeline and air hose to a cleat or a stanchion.

2. Responsibilities of the Diver

- a. **WALKING TOPSIDE.** A diver shall never walk unattended topside when he is in diving dress.
- b. **STAYING WITH AIR SUPPLY DURING DESCENT.** In going down, a diver should never get ahead of his air supply. To do so may result in serious injury.
- c. **PREVENTING FOULING.** See 6b(2) above. When working about moorings or wreckage a diver should be especially careful not to get

fouled. He should not dip under chains or lines but should, if possible, always go *over* obstacles. This is particularly important in case of a blow up. A diver should not descend on a chain or wire if it is possible to do otherwise, and neither should a chain, wire, line, or weight be veered, lifted, or moved until the diver has been brought up.

d. **AVOIDING CUTTING OF LINES.** A diver should never cut a line until he has made certain of the purpose for which it is being used.

e. **WORKING ON SHIP'S BOTTOM.** When working on the ship's bottom a diver shall not climb around holding onto something overhead. Such action may cause all the air in the dress to escape from the cuffs or through leaks in a torn glove, in which case the diver can become so heavy as to fall. The diver shall never go under the keel of a ship and up the other side but shall have the diving boat shifted when it is necessary for him to change position.

3. Putting the Diver Down

1. Where the helmet is put on or taken off at the ship's side, always secure the diver with a lifeline.
2. Don't dive a man more than 120 feet from a diving launch unless there is a standby boat with an extra air supply nearby.
3. Don't send a diver down unless BAKER is flying.
4. Don't put a diver down unless the boat or ship is in at least a 2-point mooring.
5. Never send a diver down on the screw of a ship without first informing the duty engineer and receiving his acknowledgment.
6. Never send a diver down around the hull of a submarine until the duty officer has been notified not to operate the bow planes, stern planes, sound heads, or screws.
7. Never exceed the depth for which the diver is qualified.
8. The air hose and lifeline shall not be allowed to run free when a diver is descending.

4. Safeguarding the Diver While He Is Down

- a. **GENERAL SAFETY RULES.** Weather conditions and handling of the ship are of vital importance during dives, and the following precau-

tions shall be taken to safeguard the diver:

1. Never leave a diver on the bottom in sudden squalls, heavy seas, tide, or under any condition which, in the opinion of the commanding officer, jeopardizes the security of the moorings.
2. Never attempt to shift mooring while a diver is down.
3. Never turn the screw over or get underway while a diver is down.
4. Never allow a diver to work around corners or inside a wreck without the help of another diver to tend his lines from the point of entry.
5. Never set off an explosive charge when a diver is down.
6. In all cases where diving operations are undertaken the depth of the water and the fatigue of the diver, rather than the amount of work to be done, shall determine the diver's time on the bottom.

b. RESPONSIBILITIES OF TENDER. A good tender can help a diver; a poor one is a menace. Never use a man as a tender unless he fully understands the dangers of a squeeze on blowing up and understands what steps to take in such an emergency. The tender must be fully acquainted with all signals and must be always on the alert. He shall never stand where there is a chance of his being pulled into the water and shall always be backed up by someone when the diver is going down or coming up. He shall safeguard the diver by the following means:

1. When a diver is going down a ladder the tender, backed by another man, must keep both hands on the lifeline and air hose.
2. When a diver is working on ship's bottom the tender shall keep the lifeline and air hose well in hand.
3. The tender shall never give the diver too much slack while the diver is on the bottom. To do so increases the chances of fouling.
4. He shall never try to send hand signals to a diver without first taking up all the slack.
5. He shall never give signals with long, heavy jerks, as this may hurt the diver. Signals are to be short and distinct pulls.

6. He shall never give a diver too much slack where there is any danger of a fall but shall keep a tight hold on the diver's line and give out only as much slack as is necessary.
7. He shall "fish" for the diver occasionally, taking in all slack easily and paying out as before. By this means he can tell whether the diver has shifted his position. An expert tender can do this without the diver's knowledge.
8. If a diver is blowing up, the tender shall take in his slack as fast as he ascends and shall haul him in when he reaches the surface. A check of the diver and his equipment must be made before the diver redescends.

05325 MASK DIVING

It is important to remember that mask diving is practiced only in special circumstances and that the self-contained outfits are designed only for this special work and are not suitable for general diving. This mask, helmet, and "soft" suit diving can, because of its simplicity, become the most dangerous type of diving if not properly supervised. The following precautions must be taken during mask diving:

1. Observing Depth Limits. When using shallow water diving equipment (mask, lightweight suits, pumps, and the compressors intended for use with this equipment) the depth limits as set forth in current instructions must never be exceeded.

2. Restricting the Time. The time of a dive—that is, the time from leaving the surface for descent to the time of starting the ascent—shall not exceed the time listed in the recompression tables when no stage decompression is required.

3. Requirements of the Diver

1. In shallow water diving the man going down must be a qualified diver and a first-class swimmer.
2. Dives must be made with a lifeline attached around the waist; this line must be securely fastened above the belt.
3. In helmet and mask diving, called "skin" diving, the diver must be able to rid himself instantly of all equipment except his lifeline, as he may find it necessary to

swim to the surface. Only a belt with a quick release shall be used.

4. The diver must remember not to duck the mask while on the bottom, except in an emergency, in which case he should exhale continuously while ascending. While at work he should always be in the clear, in order to permit direct ascent to the surface.

05326 OXYGEN-HELIUM DIVING

The safety precautions covering procedures, equipment, and methods of working on the bottom when using standard equipment apply also to oxygen-helium diving. (See articles 05321 through 05324.) The following additional precautions shall be taken:

1. Preparing for the Dive

a. PREPARING AND CHECKING GAS. Oxygen-helium diving should not be undertaken until sufficient quantity of gas has been prepared and checked for proper composition.

b. CHECKING ASPIRATOR AND CANISTER. The aspirator and canister must be checked to see that they are functioning correctly. Fifty

pounds of gas supply pressure over bottom pressure should be maintained.

c. VENTILATING THE HOSE. Before the diver is put down the hose should be ventilated to ensure that the diver is actually breathing a helium-oxygen mixture. The change in tone of the diver's voice as he begins to breathe helium is distinct and easily recognized.

2. Safety During the Dive

a. ASSURING ADEQUATE VENTILATION. If the diver develops symptoms of inadequate ventilation while on the bottom there should be no hesitation on his part to by-pass the venturi supply by periodically opening his control valve as conditions warrant. To compensate for this excess supply the chin button will have to be used more frequently to prevent blow up. When the diver reaches the surface an investigation for the cause of the faulty ventilation should be undertaken at once.

b. AVOIDING TOXICITY. While breathing oxygen at the 50- and 40-foot stops the diver must keep any form of exertion or exercise to a minimum, since activity increases susceptibility to oxygen toxicity.

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United States Navy
SAFETY PRECAUTIONS

Chapter 6
POWER TRANSMISSION

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Subsection A
MAIN PROPELLING MACHINERY

**06101 UNINTENTIONAL STARTING OF
ENGINES**

Precautions against the unintentional starting of an engine must be carefully observed before overhauling operations are begun.

1. **Main Engine Clutch.** The main engine clutch must be disengaged.

2. **Jacking Gear.** The jacking gear should be engaged on an engine which is connected to a propeller shaft by a hydraulic clutch:

1. if the main motors in the compound drive have been started;
2. if the ship is under way.

This precaution will avoid the danger of windage in the clutch turning the crankshaft.

06102 RELIEF VALVES

1. **As Trouble Indicators.** If one of the relief valves on the working cylinders or on an air compressor blows several times, the engine or air compressor is to be stopped and the trouble corrected.

2. **As Safeguards Against Fire and Explosion.** Pressure relief mechanisms are fitted on enclosures where the ignition of oil vapor may possibly occur. The designated dimensions and adjustments are to be strictly followed.

3. **Locking.** Relief valves are never to be locked in a closed position except in case of emergency.

06103 AIR LINES

When the engines are stopped, starting-air and spray-air lines must be vented. Serious accidents may occur if the pressure is left on.

06104 RECIPROCATING STEAM ENGINES

1. **Warning to Be Sounded.** Before an engine is moved by steam, a *stand clear* warning is to be sounded. Sufficient time should be allowed for co-workers to heed this warning before the engine is started.

2. Jacking Gear. When an engine is under steam, or when it has a vacuum in the condenser, the jacking gear must be engaged before a worker may enter the crank pit.

06105 ELECTRIC PROPULSION INSTALLATIONS

1. Entering Cubicle

1. Deenergize exposed conductors before introducing any part of the body into the control cubicle or other propulsion equipment.
2. Do not enter the propulsion control cubicle when buses are energized unless it is necessary to observe the operation.

2. Starting Engines

1. Inspect electrical machinery for loose bolts, improper clearances, shorted connections, broken insulation, or damaged parts.
2. Disengage the jacking gear before starting the engines.
3. Do not attempt to force the switches closed against the action of the mechanical interlock.

3. Care of Equipment

1. Do not allow water to drip or spray on electrical equipment from vent outlets, open hatches, or condensation on pipes and cables.
2. Securely fasten removable covers and access doors to power panels, control cabinets, and switchboards.

06106 FIRE PREVENTION AND FIRE FIGHTING

1. General. Chapter 18 of this publication, *Electricity and Electronics*, should be studied for an understanding of fire prevention in areas where electrical equipment is used. The following procedures shall be followed in case of fire.

1. Maintain CO₂ fire extinguishing equipment at hand and ready for instant use.
2. In case of fire, shut off the machinery and deenergize the line circuits.
3. Never use water or foam solution to extinguish the fire unless the circuits are de-

energized and the fire gets out of control. Since water and foam solutions are electrical conductors, they may spread the fire.

4. Close the ventilating systems in the affected compartments.
5. If the fire is in a compartment adjacent to one of the engine rooms, excessive smoke and gases may be removed by starting the engines and drawing engine induction air from the compartment where the fire is located.
6. Exercise precautions against smothering personnel when using firefighting equipment.
7. Determine the cause of the fire and take corrective measures.

2. Fire Extinguishers in Old and New Installations. The old turbine-electric propulsion installations have a water or steam system for extinguishing fire within a propulsion generator or motor; the newer installations have a carbon dioxide system for this purpose. Both old and new installations are equipped with carbon dioxide extinguishers which can be used to fight fire in the propulsion control cubicles and cables.

3. Fire in Propulsion Generator or Motor. In case of fire in the propulsion generator or motor, observe the following precautions:

1. Report the fire to the propulsion control room.
2. Deenergize the equipment and reduce the speed as quickly as possible.
3. If motor-driven ventilating blowers are installed on the machine in which the fire has occurred, the blowers should be secured.
4. If a steam or water fire-fighting system is installed on the affected machine, do not admit steam or water to the machine until ordered to do so by the appropriate supervisor.

5. If a carbon dioxide extinguishing system is installed on the affected machine, remove the covers on the machine and admit carbon dioxide through the openings provided for that purpose.

4. Fire in Propulsion Control Cubicles or Cables. In case of fire in the propulsion control cubicles or cables, deenergize the equipment and extinguish the fire with carbon dioxide.

Subsection B

PUMPS

06111 RECIPROCATING PUMPS

The following precautions are to be observed in connection with reciprocating pumps:

1. Never use a jacking bar to start a pump while the steam valve to the pump is open.
2. Do not use boiler-feed pumps for any purpose other than the service of the boilers or the use of feed water except in an emergency.
3. Before opening a steam cylinder or steam-valve gear, be sure the drains are open and the steam and exhaust root valves are wired closed.
4. Before opening the water cylinder or valve chest of a pump which handles water at a temperature in excess of 120° F., make certain the suction and discharge valves are wired closed and the cylinder and valve chests are drained.

06112 CENTRIFUGAL, PROPELLER, AND ROTARY PUMPS**1. General Operating Procedures**

a. **TESTING RELIEF VALVES.** Test relief valves of positive displacement rotary pumps to determine whether they function at the designated pressure.

b. **JACKING PUMP.** Never attempt to jack a pump by hand while the steam valve to the driving unit is open.

c. **GOVERNORS.** Do not tie down, or in any other manner make inoperative, the overspeed trip or the speed-limiting or speed-regulating governors.

d. **CHECKING GOVERNORS.** Check the speed-limiting and speed-regulating governors at least quarterly to determine that they are set to limit the speed of the unit to the rated speed under rated conditions.

e. **CHECKING OVERSPEED TRIP.** Check the overspeed trip at least quarterly to determine that it is properly set. Overspeed trips should be set to shut off steam to the unit when the rated speed is exceeded by ten percent.

f. **SPEED FOR LOADING.** Be sure the rated speed is not exceeded by more than five percent for any condition of loading.

g. **GLANDS.** Make certain that glands on pumps carrying petroleum products or other hazardous liquids are in good condition and not leaking.

2. **Rotary Pump Discharge Valves.** Never operate a positive displacement rotary pump with the discharge valve closed unless the discharge is protected by a properly set relief valve of sufficient size to prevent a dangerous rise in pressure.

3. **Centrifugal and Propeller Boiler Feed Pumps.** Do not use boiler feed pumps and other pumps in the feed system for any purpose other than boiler or feed water service, except in an emergency.

06113 PUMP PRESSURE-REGULATING GOVERNORS

Personnel will maintain the same diligence while operating machinery with automatic control devices as when operating machinery which does not have such devices.

Subsection C

GUARDS

06121 GEARS AND FRICTION DRIVES

1. **Encasement.** Gears and friction drives should be completely encased. In gears where this is impracticable, a band guard shall be provided with side flanges extending inward beyond the roots of the teeth.

2. **Spoke Hazard.** Where there is a spoke hazard, the gears must be enclosed on the exposed side.

06122 SPROCKETS

Sprockets, wherever located, must be completely encased, and the chain must be substantially guarded.

06123 BELTS

1. **Specifications for Guards.** If the guard or enclosure is within 4 inches of the belt, it shall not be less than 6 feet in height. Openings in the guard which are wider than one-half inch are to be protected by substantial material, such as wire netting of not more than one-half inch. Mesh is to be constructed of wire not smaller than No. 16 gage U. S. Standard.

2. **Inclined Belt Guards.** Except where the lower run of an inclined belt is at least 6 feet and 6 inches from the floor, the belt must be completely guarded to that height.

3. **Panel Support.** A panel in a guard that is wider than 42 inches shall be supported across its width.

4. **Overhead Belt Guards.** An overhead horizontal belt with a lower run which is less than 7 feet from the floor or platform level must be guarded on the bottom and sides to a height not less than 6 inches above the lower run of the belt. However, in no case is it necessary for

the guard itself to be more than 7 feet in height.

5. **Passageways.** Pulleys which are of a size and location to permit passage between the upper and lower runs of the horizontal belt shall be provided with standard railing. A substantial passageway which is guarded on the sides and top must be constructed. If such guard is not provided, all space traversed by the belt must be completely barred against passage.

06124 SHAFTING

Vertical and inclined shafts shall be encased with stationary guards to a height of 6 feet from the floor or platform level. Horizontal shafting which is less than 6 feet from the floor or platform level shall be completely encased with stationary guards.

06125 GENERAL STANDARD GUARDS

1. **Uprights.** The uprights used for supporting the guards should be made of angle iron $1 \times 1 \times \frac{1}{8}$ inch, to $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{16}$ inch, iron pipe $\frac{3}{4}$ inch to $1\frac{1}{2}$ inch inside diameter, or construction of equivalent strength. The sizes should vary between these limits according to the weight and size of the guard, its location in relation to aisles, and the possibility of its being damaged by moving equipment.

2. **Fastenings.** The filling material should be fastened to the supports in the following manner: $\frac{3}{4}$ inch by $\frac{1}{8}$ inch flat iron fastened to the angle by means of $\frac{3}{16}$ inch bolts or rivets placed at intervals not exceeding 10 inches, or wooden strips 1 inch by 1 inch fastened to angles by means of $\frac{3}{16}$ inch bolts. Other methods providing equivalent strength may be used.

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Subsection A

MARINE BOILERS

06201 GENERAL CARE

1. Testing

a. **PRESSURE TESTS.** Hydrostatic tests at $1\frac{1}{4}$ times the boiler-design pressure shall be conducted to prove the tightness and strength of the marine boiler and its parts:

1. after each renewal of pressure parts;
2. at subsequent intervals of three months.

After a boiler has been in service for five years it should be given a hydrostatic test at these same two intervals, at $1\frac{1}{2}$ times the design pressure.

b. **TUBES IN WATER-TUBE BOILERS.** The straight portions of tubes in water-tube boilers shall be tested with a straight-edge regularly to detect deflection.

c. **STEAM GAGES.** The boiler steam gages shall be tested at regular intervals.

d. **OIL HEATER DRAIN.** The drain from the oil heater shall be tested at least once each hour.

e. **STEAM-SMOTHERING PIPES.** The permanently installed steam-smothering pipes shall be examined and tested by steam at least once each month.

2. **Inspection, Cleaning, and Repairing.** A boiler shall be thoroughly ventilated after boiling out before men are sent into the interior for cleaning and repairing operations. While men are working inside a boiler, a man shall be stationed outside to render any necessary assistance.

a. **REMOVING PARTS.** Before removing parts or

fittings subject to pressure, or before loosening a manhole or handhole plate-fitting of a boiler which has been under steam, the air cock and the test and water gage cocks connected with the steam space must be opened to insure a complete absence of pressure.

b. **VALVES.** While the boiler is being cleaned or repaired, valves which might permit the entrance of steam or water into the boiler shall be tagged, closed, and secured by locking or wiring in order to prevent accidental opening.

c. **CORROSION.** A systematic inspection of marine boilers shall be made. The exteriors of boiler drums shall be watched for signs of corrosion under the coverings. Rusty streaks from the coverings or around the tubes or pads on the drums shall be investigated immediately.

d. **DEPOSITS ON HEATING SURFACES OF BOILERS.** Boilers which have deposits on their heating surfaces, or which have grease or other foreign matter in the water, shall be cleaned at the first opportunity.

e. **DRAIN HOLES AND DRIP PANS.** The drain holes and drip pans of registers of air-encased and bulkhead-enclosed boilers shall be inspected, and shall be cleaned, if necessary, at least once each watch.

f. **BILGES.** The bilges of non-air-encased, oil-burning boilers operating in open firerooms should be washed or steamed out once each watch. When the boilers are operating under

forced draft in closed firerooms (or boiler rooms), the bilges shall be inspected twice each day and shall be cleaned if necessary.

g. **FUSIBLE PLUGS IN FIRE-TUBE BOILERS.** Fusible plugs shall be examined when the boiler is cleaned and shall be renewed at least once a year.

3. Electrical Equipment

a. **LIGHTS.** The use of naked lights in an open boiler is prohibited. Portable electric lights may be used, but hand electric flashlights are preferable. If portable electric lights are used, the bulbs must be adequately covered with wire or rubber guards. The electric leads must be thoroughly insulated. The insulation is to be checked before the leads are used. To avoid the possibility of shock from extension cords in wet or grounded areas as in boilers, a portable transformer can be used. The transformer steps the voltage down to six volts.

b. **GROUNDING.** The entire electrical installation in spaces containing flammable vapors should be tested for grounds and defects remedied before sending men into such areas. The test for grounds shall be made from the switchboard outside the fouled spaces, and any repairs shall be made with the circuit dead.

4. **Blowing Down.** The division wall headers, water screen headers, and water wall headers of a boiler are not to be blown down until all burners have been secured.

5. **Closing Boilers.** Before a boiler is closed, workers are to make certain that no one has been left inside.

6. Draining and Opening

a. **APPROVED METHODS.** A boiler should be emptied by either of the following methods:

1. Pump down with a reciprocating fire-and-bilge pump or a portable pump connected by a hose to the bottom blow, superheater drain, and economizer drain valves. This method is preferable.
2. Flood the bilges with about 12 inches of water, drain the boiler to the bilges, and pump the latter dry.
3. A steel drum fitted with a hose connection for pumping out may be used to advantage to clear the drains, particularly those from the superheater and economizer.

b. **PROHIBITED METHOD.** No one shall attempt

to empty a boiler overboard through the bottom blow sea valve except in an emergency.

06202 PLACING BOILERS IN OPERATION

1. **Testing.** Safety features are to be tested and in proper working condition.

2. Lighting Off

1. Blow through the furnaces of oil-burning boilers with air or steam before lighting off, and before relighting when all atomizers have been extinguished, except on the superheater side of the superheat control boilers.

2. In boilers fitted with integral superheaters, open the superheater discharge connection to the auxiliary exhaust line before lighting the first burner; then open the protection steam connection to the superheater inlet.

3. Use a torch and stand well to one side of the register when lighting off a dead boiler in order to avoid injury from flareback. A torch should also be used to light off additional burners if the furnace is relatively cold or if the burners are large or widely spaced.

4. Never cut in burners at a greater rate than that prescribed in article 51-631 (36) (a) (3), *BuShips Manual*.

5. Never light a burner on the superheater side of a superheat control boiler until the required steam flow is established through the superheater.

6. Never light a burner on the superheater side unless one or more burners are in operation on the saturated side.

7. Securely fasten dampers open and allow time for ventilation before lighting burners.

06203 OPERATION OF BOILERS

1. Oil

1. Before using oil from the tank, pump the water in the settling tank overboard.

2. Do not use oil from a tank in which there is a considerable amount of water mixed with the oil.

3. Keep oil joints tight.

4. Test the drain from the oil heater at least once every hour.

5. Close down the boiler stop at once when the suction of the oil service pump is lost.

2. Steam Pressure

1. Never allow the authorized maximum steam pressure to be exceeded.
2. Never shut off the feed supply, even for a short period, while the boiler is furnishing steam.

3. Water Level

1. The fireman assigned to the feed checks shall have no other duty than maintaining the proper water level.
2. Unless there is another apparent reason for it, a fall in steam pressure may indicate low water.
3. Immediately use the try cock (if installed) if the water in the gage glass falls out of sight.
4. If the water drops below the lowest try cock or out of sight in the water gages, shut off the oil supply or deaden the fires, ease open safety valves, and close all openings into the boiler.
5. Blow the water gages once each hour.
6. Check the water level by try cocks (if installed) at least once each watch.
4. **Furnace Break.** Cut out the boiler at once if a brick drops out of the furnace wall.

5. **Flarebacks.** Stand clear of the possible path of a flareback, as far as it is possible to do so, during gunfire. The possibility of flarebacks may be reduced as follows:

1. Keep atomizer valves tight.
2. Do not allow oil to accumulate in the furnace.
3. Shut off the oil and blow through with steam or air before relighting the atomizers when the fires are accidentally extinguished.
4. Never relight atomizers from a hot brick wall.
5. Never leave disconnected atomizers in place.
6. Avoid white smoke from any cause, since it is frequently an indication of explosive mixtures. (Explosive mixtures of soot or gases in tube-banks and uptakes may be caused by large amounts of excess air.)
6. **Blow Burners.** Observe the following pre-

cautions when operating individual blow burners:

1. In an open fireroom, never permit the furnace air pressure to be greater than a negative one-tenth inch of water.
2. Before relighting a rotary cup-type burner that has been accidentally extinguished, operate the burner blower on it at maximum speed long enough to insure that the furnace has been cleared of explosive gases.

06204 SHUTTING DOWN A BOILER

1. Closing Valves

1. Do not close the master oil valve until the pump is secured except in case of emergency.
2. Open the discharge connection to the auxiliary exhaust before closing the main steam stop valves of a boiler with an integral superheater.
2. **Securing Burners.** When shutting down a superheat control boiler, secure the burners on the superheater side prior to securing those on the saturated side. Reduce the steam temperature slowly to prevent leakage at steam line joints.

3. Air-Control Registers

1. Never close the dampers on oil-burning boilers, except when the air-control registers are being repaired.
2. Remove atomizers from registers as soon as possible after securing.
4. **Emptying.** See 06201,6 for methods of emptying a boiler.

06205 FORCED DRAFT FANS

1. General Care

1. Turn the fan by hand daily and before admitting steam to the casing.
2. Never open fan hood flaps in a closed fire-room installation under forced draft unless the blower is running and is ready to take the load.
3. In open fireroom installations (double cased boilers or draftbox on front of boiler), when more than one forced draft fan is installed per boiler, close attention should be given to automatic shutters on any secured fans. Automatic shutter me-

chanisms gum up after several years operation. If the shutter sticks open, the supposedly secured fan will windmill backwards and burn out the bearings.

2. Oil Reservoir. Keep the oil reservoir well filled with clean oil at all times.

3. Rotating Parts

1. Keep fan and rotor properly balanced at all times.

2. Do not paint rotating parts.

3. Before starting the fan inspect it to see that it is clear of foreign matter.

4. Closed Fireroom

a. REMOVING INTAKE COVERS. Before fans are put in operation the intake covers shall be en-

tirely removed. If these covers are hinged, they shall be so altered that the hinge pins can be taken out for the purpose of removing the covers.

b. CLOSING INTAKE. Never close the intake of a forced-draft fan after the fan has been put in operation and has taken the load. This procedure takes the load off a centrifugal fan, causing it to race. In any case, it decreases the air pressure in the fireroom and causes danger of a flareback.

5. Open Fireroom. Before starting a secured forced draft fan, check the automatic shutter to determine that locking devices (if installed) have been released.

Subsection B

FIREROOMS (AFLOAT AND ASHORE)

06221 GENERAL CARE

1. Ventilation. Men shall not be permitted to work in a dead fireroom unless adequate ventilation is provided. Special care shall be taken to insure an adequate supply of fresh air in a dead fireroom if the boilers in that fireroom are connected to the same smokepipe as steaming boilers in another fireroom.

2. Automatic Stokers and Ash Conveyors. Work is not to be performed on automatic stokers and ash conveyors while they are in motion.

3. Temperature. Firerooms shall be kept above 40° F. when there is water in the boilers and pipe lines.

4. Watch. No one shall stand a fireroom watch unless he is thoroughly familiar with the precautions contained in this section.

5. Housekeeping

a. GENERAL. The general rules for good housekeeping as set forth in chapter 2, are to be observed insofar as they are applicable in the fireroom.

b. ASHES. Ashes are to be removed from the fireroom daily.

c. GRATINGS. Gratings over fireroom and engine room hatches shall be kept in place. These gratings are to be kept clear and are not to be used for stowage space.

06222 EMERGENCY PROCEDURE

1. Machinery. In case of accident the situation shall be localized if at all possible.

1. The compartment involved shall be isolated to prevent escaping steam from getting into other boilers and machinery.
2. All men shall remain at their stations and give strict attention to the machinery in operation.

2. Personnel

1. Men shall not be permitted to go up the ladders when considerable leaks of steam occur in a fireroom, since at such times the upper part of the compartment generally becomes filled with steam.
2. If it becomes necessary to abandon the compartment, personnel shall proceed to another compartment on a lower level.

06223 FIRE PREVENTION IN FIREROOMS

1. Oil

a. HAZARDS. Spilled oil shall be wiped up immediately. Oil is not to be allowed to accumulate on furnace bottoms, in inner casings, bilges, pockets, etc.

b. TEMPERATURE LIMITS. The temperature of fuel oil shall never be raised to or above the flash point in any part of the system except

between the heaters and the atomizers. In no case shall oil be heated to a temperature higher than that necessary to reduce the viscosity of the oil to 135 seconds Saybolt Universal.

c. PRESSURE LIMITS. When a fuel-oil burning system is designed for 300 pounds per square inch oil pressure, the pressure in any part of the system shall not exceed that which is necessary to produce this amount at the burner manifolds on the boiler fronts. Nor shall the pressure at the fuel-oil service-pump discharge exceed 350 pounds per square inch gage.

2. Open Flames

a. EQUIPMENT. Open lights and flames, such as oil lanterns, matches, candles, etc., are not permitted in oil-burning firerooms.

b. SMOKING. Smoking is prohibited in oil-burning firerooms except on floor plates in front of steaming boilers.

3. Boilers. Boilers which have deposits on their heating surfaces, or which have grease or other foreign matter in the water, shall not be steamed at high firing rates except in cases of great emergency. These boilers shall be cleaned at the first opportunity.

4. Ashes. Ashes are to be wet down immediately. They are never to be placed in flammable containers.

5. Applying Metal Conditioning Compound

1. Do not smoke.

2. Do not apply the compound while another boiler in the same fireroom is steaming or while the boiler is connected to the same smoke pipe as another boiler which is steaming.

3. Avoid using excessive amounts of the

compound, which can collect in pockets which would be subject to high temperature when steaming.

4. After a boiler has been sprayed with the compound, do only emergency work inside the boiler or uptakes until the compound has been removed by firing the boiler.

5. Take particular care to detect fires which might occur when the boilers are first steamed after application of the compound.

6. The use of compound shall be in accordance with the instructions given in chapter 51, *Bureau of Ships Manual*.

06224 FIRE FIGHTING

1. Fire Extinguishers. Fire extinguishers are to be kept in proper working condition.

2. Fire in the Bilges. In case of fire in the bilges the master valve shall be closed and the oil pump stopped.

3. Fire in the Casing. In case of fire in the casing of an air-encased boiler, the steam-smothering system in the casing shall be used immediately.

4. Fire in a Bulkhead-Enclosed Boiler Room. The steam-smothering system shall also be used immediately in case of fire in a bulkhead-enclosed boiler room. It must be determined prior to using the steam-smothering system that personnel are out of the boiler room.

5. Oil Fires. When an oil fire occurs, the blowers shall be shut down unless they will aid personnel to escape by keeping the flames away from possible exits.

Subsection C

STATIONARY BOILERS

06231 GENERAL

1. Ventilation. As a protection against toxic or explosive gases, boiler settings are to be ventilated completely and tested for the presence of toxic or explosive gases before workers are permitted to enter.

a. MANHOLES. On boilers having a manhole on each side of the drum, the covers of both man-

holes shall be removed for ventilation purposes before men enter the drum.

b. FAN. When practicable, a ventilating fan is to be operated in the drum when men are working in the boiler.

c. STOP VALVE. Steam and feed lines connecting to headers under pressure shall be isolated by a stop valve and a blank with open tell-tale valve in between, or by two stop valves

with tell-tale valve opened in between, before men enter steam drums, mud drums, or other water side enclosures.

2. Testing

a. HYDROSTATIC TESTS

1. New stationary boilers should be given a hydrostatic test at $1\frac{1}{2}$ times their working pressure before they are placed in service.
2. Subsequent hydrostatic tests shall be made once a year except in the case of boilers which are twenty years old (as indicated by the date of manufacture) and which have a working pressure over 15 p.s.i.; these shall be tested twice a year.
3. Hydrostatic tests are to be made after repairs on boiler surfaces to assure their tightness.

b. VALVE TESTING. Workers shall not be inside the water side of the boiler when pressure is being applied to test a valve which has not been under pressure.

c. STEAM GAGE TESTING. The boiler steam gages shall be tested quarterly. They should be tagged to indicate the date of the tests.

d. TUBE TESTING. To detect deflection, the straight portions of tubes in water-tube boilers shall be tested with a straight-edge regularly.

e. BOILER WATER TESTING. Boiler water is to be tested in accordance with directions contained in the *Bureau of Yards and Docks Technical Publication, TP-PU-3, Power Generation and Distribution*. Workers are to wear rubber-frame goggles when testing water to prevent acid fumes from irritating the eyes.

f. CONTROLS TESTING. The automatic controls and safety devices of automatically operated boilers shall be tested manually at stated intervals by qualified inspectors. The schedules for these safety checks are to be established by the public works officers at their respective installations.

3. Cleaning and Repairing

a. ADJUSTING PRESSURE. Performing certain adjustments and repairs while pressure is up is prohibited. A complete absence of pressure is to be insured by opening the air cock or test and water gage cocks connecting with the steam space:

1. before fittings or parts subject to pressure are removed;

2. before manhole or handhole plate-fittings are loosened on a boiler which has been under pressure.

Combustion control, feed control, and burner, stoker, or similar adjustments are permitted with the boiler steaming, recognizing that many adjustments can only be made when pressure is up.

b. PERSONAL PROTECTIVE EQUIPMENT. When performing cleaning operations workers should wear the proper personal protective equipment.

1. Hard hats and goggles should be worn.
2. When a worker is chopping slag inside a furnace, a respirator should be worn.
3. Safety-toe shoes or toe-guards should be worn to prevent injuries from falling slag.

c. ENTERING FURNACE

1. A worker is not to be allowed to enter a stoker-fired furnace until the stoker-motor control has been tagged with a "Hold" card.

2. When a man is working inside the furnace, a large warning sign, such as CAUTION — MEN WORKING INSIDE, shall be placed near the furnace entrance.

d. OPEN-FLAME LIGHTS. The use of open-flame lights is prohibited in boilers. When cleaning where flammable vapors and gases may be present, workers are to use only explosion-proof portable lamps equipped with heavily insulated 3-wire conductors, with one conductor connecting the guard to the ground.

e. OIL ACCUMULATION. Any oil which has accumulated on furnace bottoms shall be cleaned out immediately.

f. STRAINERS. The fuel-oil suction and discharge strainers shall be cleaned at least every eight hours, and oftener if necessary.

4. Inspection

a. GENERAL. General inspection of the boilers shall be made twice a year at the convenience of the activity, unless other instructions are received from the public works officer. Instructions regarding periodic boiler inspections as applicable to the Shore Establishment are given in *Bureau of Yards and Docks Technical Publication, TP-PU-3*.

b. IDLE BOILERS. When in a state of preservation, idle boilers of all working pressures shall

be inspected by a qualified boiler inspector twice a year. The boilers shall be given hydrostatic tests and approved for use before being placed in operation.

c. AIR LEAKS. Boiler settings shall be examined daily for external air leaks. Cracks, blisters, or other dangerous conditions in joints, tubes, seams, or blow-off connections are to be reported to the proper authority immediately.

d. DEPOSITS ON THE HEATING SURFACES. Boilers shall also be regularly examined for deposits on their heating surfaces or for grease or other foreign matter in the water. Boilers showing any such irregularities should be cleared at the first opportunity and should not be used until cleared except in an emergency.

e. FOREMAN'S INSPECTION. After cleaning and repairing operations have been completed, the foreman shall make a thorough inspection.

1. He should make certain that tools, scraps, and foreign materials have been removed from the boiler.
2. Before closing the steam drains and headers, he must determine that no member of the crew is inside the boiler.

5. Condensate Pits. Condensate pits in boiler rooms shall be provided with metal covers. Where it is necessary that such pits be open for maintenance, adequate guards shall be placed around them and warning signs posted.

06232 OPERATING PRECAUTIONS

1. Watch and Equipment Requirements

a. EQUIPMENT. Wear goggles with dark lenses, number 1.5 to 3 shade, and suitable fire-proof face shields when working near or looking through furnace doors of boilers in operation.

b. MINIMUM ATTENTION TO BOILERS. Unless otherwise directed by the public works officer, the minimum attendance required for the operation of automatic steam boilers during steaming periods shall be as follows:

1. For boilers operating at a working pressure of 15 p.s.i. or less, no continuous attendance is required.
2. For single boilers of not more than 100 boiler horsepower which are operating at a working pressure above 15 p.s.i., but not

more than 100 p.s.i. a visual inspection is to be made at least once every four hours.

3. Continuous attendance is required for single boilers over 100 boiler horsepower and for multiboilers. The number of operators depends upon the number and size of the boilers.
4. For boilers operating at a working pressure above 100 p.s.i. continuous attendance is required. The number of operators is dependent upon the number and size of the boilers.

c. WATCH. No one shall stand a fireroom watch until he is thoroughly familiar with the precautions contained in this section.

2. Firing

a. DAMPER. Open the stack damper or operate the induced draft fan before starting a fire.

b. VENTS AND DRAINS. When firing a cold boiler be sure that the air vents are open on the boiler proper and that the drains are open on the superheater; these should be kept open until steam is liberated from the openings. Superheater vents must remain open until the boiler is on the line.

c. COMBUSTIBLE GASES. Be sure that gas-fired and oil-fired boilers, whether manual or automatic, are cleared of combustible gases after each false start.

d. USE OF TORCH. When lighting fires in furnaces in oil-fired, gas-fired or pulverized-fuel-fired boilers, use a torch for each burner. Never try to start fires from hot brick work, and do not attempt to light one burner from another.

e. RATE OF FIRING. Prevent overheating of boilers equipped with superheaters by firing at a slow rate during the warm-up period and allowing a small amount of steam to flow through the superheater.

3. Water Level

a. USE OF GAGE. When taking over a watch, blow the water gages and note the return of the water in the glass. Be certain of the water level at all times. Do not be misled by a dirt marking on the gage which may look like the surface of the water. Do not depend entirely upon automatic alarm devices and automatic feedwater regulators.

b. TRY COCK. If there is any question about

the water level use the try cock. One-half glass of water shall ordinarily be carried.

c. LOW WATER. If the water goes out of sight in the bottom of the gage glass, kill the fire, immediately close the steam stop valve, and allow the boiler to cool slowly; then drain the boiler completely and open it for inspection. *Do not feed cold water to a boiler that has had low water until the boiler has cooled.*

d. STEAM

1. Check the water on steaming boilers by try cocks at least once each watch and before connecting a boiler to the line.
2. Blow down the water glasses before connecting a boiler to the line.
3. Remember that a fall in steam pressure may indicate low water.

4. Valves

a. CHECKING. Check safety valves at frequent intervals to be sure they will pop at the correct pressure, as marked on the nameplate.

b. SEAL. Do not break the seal of a safety valve or change its adjustment unless such action has been authorized.

c. WEIGHTING. Never weight the pop valves or relief valves, etc., to increase the recommended steam pressure for which the boiler is approved.

5. Oil

a. OIL AND WATER MIXTURE

1. Do not use oil from a tank in which a considerable amount of water is mixed with the oil unless a high suction connection is provided.
2. When an atomizer sputters, shift the suction to the stand-by tank or another storage tank. A sputtering atomizer indicates water in the oil.

b. FOULING. Minimize the fouling of oil heaters by using as few heaters as possible. Recirculate the oil through the used heaters for a short time after securing the burners.

c. TEMPERATURE. Maintain the prescribed fuel-oil temperature; do not exceed it.

6. Accidents

a. TO FURNACE WALL. Cut out the boiler at once if a brick falls out of the furnace wall.

b. STEAM LEAKS. If a large steam leak occurs in a boiler, shut off the burners, feed water until the fire is out, close the steam stop valve, ease the safety valves, clear the furnace of gases, close the registers, and cool the boiler slowly.

7. Adjusting Parts. Do not tighten a nut, bolt, or pipe thread, nor strike any part, nor attempt to make any other adjustments to parts while the boiler is under steam or air pressure.

8. Foreign Substances. Exercise precautions to prevent lubricating oil, soap, or other foreign substances from getting into the boiler. Condensate from cleaning vats should be led to waste and not returned to the boiler.

9. Closing Furnace. Close the furnace openings as soon as all fires have been extinguished and the furnace has been cleared of gases.

10. Unattended Boilers. Where unattended boilers are in operation, boiler room doors should be provided with locks and kept locked during periods of nonattendance.

06233 FIRE PREVENTION

Detailed measures for the prevention and extinguishment of oil fires can be found in chapter 17. In addition, the following precautions are emphasized:

1. Keep the joints on oil lines tight.
2. Do not permit oil to accumulate on the furnace bottoms or on fireroom floors.
3. Scot blowers shall be used as frequently as necessary to keep boiler surfaces which are exposed to fire and gases clean.
4. When fires are banked, make certain the draft is sufficient to carry off flammable gas accumulations.
5. Do not use water to extinguish an oil fire in the furnace.
6. In case of an oil fire in the boiler room, close the master fuel-oil valve and stop the oil pump.

Section 3

AIR RECEIVERS AND COMPRESSORS (UNFIRED PRESSURE VESSELS)

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06301 GENERAL CARE

1. **Inspection.** Unfired pressure vessels must be constructed in accordance with accepted applicable codes of the American Society of Mechanical Engineers. Instructions regarding inspections of unfired pressure vessels as applicable to the Shore Establishment are given in *Bureau of Yards and Docks* Technical Publication, TP-PU-3, chapter 7. The following additional rules apply:

a. **VISUAL INSPECTION OF VESSELS.** Acceptable practice requires a careful external visual inspection once a year and an internal visual inspection of vessels with openings once every two years.

b. **INSPECTION OF EQUIPMENT.** No set rules can apply to the inspection of equipment such as hot water heaters, steam autoclave sterilizers, steam-jacketed cooking utensils, small air receivers associated with fire extinguishing systems, and portable and mobile air compressors. However, arrangements for inspection on the basis of the existing situation shall be made and adequate maintenance provided.

2. Testing

a. **HYDROSTATIC TESTING.** Where visual inspection results in suspicion of the soundness of the vessel, or where the condition of the vessel indicates a need to check for leakage following repairs, the vessel should be tested hydrostatically to $1\frac{1}{2}$ times working pressure. Vessels which will not suffer surface injury from hammering should be hammer-tested if hydrostatic tests are not conducted.

b. **TESTING OF UNFIRED GASEOUS PRESSURE VESSELS.** Unfired gaseous pressure vessels of over 15 p.s.i. working pressure should be inspected visually and tested hydrostatically once a year, except as indicated in the following paragraphs:

(1) *High Pressure Gaseous Cylinders.* The testing of high pressure gaseous cylinders used for helium, hydrogen, oxygen, acetylene, and similar gases shall be in accordance with the regulations of the Interstate Commerce Commission, which require a hydrostatic test once in five years with determination of permanent and temporary cylinder expansion.

(2) *Storage Containers.* The testing of large spherical containers for the storage of helium or other gases shall be accomplished in accordance with the recommendations of the manufacturer.

c. **TESTING OF OTHER PRESSURE VESSELS.** The procedure for the testing of pressure vessels which are not suited to hydrostatic tests for any reason, including inadequate structural support, shall be determined specifically by correspondence with the Bureau of Yards and Docks.

d. **TESTING AND TAGGING.** The control valves shall be inspected and tested once a year. Control valves for pressure vessels should be plainly marked, either by tags describing the function of the valves or by means of a distinctive color system. The methods usually employed for locking and tagging control valves for boiler inspection and repair should be used also for unfired pressure vessels.

06302 AIR RECEIVERS (COMPRESSED AIR TANKS)

1. **Operating Pressure.** Do not operate an air receiver at a pressure higher than the maximum allowable working pressure unless such operation has been specifically authorized.

2. **Unauthorized Use of Compressed Air.** Do not use compressed air to accelerate the flow from containers of oil, gasoline, or other fluids. This practice is dangerous to the operator and fellow workers and is prohibited.

3. **Cleaning and Repairing**

1. Never attempt to make repairs of any nature while the air receiver is under pressure.

2. Carefully observe precautions for cleaning air receivers. When air receivers are of sufficient size to admit a man through a manhole opening, the manhole covers should be completely removed. Adequate ventilation must be provided, and there must be no oxygen deficiency, no volatile gases, and no carbon monoxide present in dangerous quantities.

06303 AIR COMPRESSORS

1. **General Care**

1. Be sure the air at intake is cool and free from flammable gases, vapors, or dusts.

2. Do not permit wood or other flammable materials to remain in contact with the air discharge pipe.

3. Immediately secure a compressor if the temperature of the air discharged from any stage rises unduly or exceeds 400° F.

4. Do not install a stop valve or check between the compressor and receiver unless a relief valve is also fitted between the compressor and the stop or check valve. (If the compressor is started against a closed valve or a defective check valve the air cannot escape and an explosion will result.)

5. Pressure gages shall never be rendered inoperative except when they are to be removed for some valid reason.

6. Never kink a hose to stop the air flow. Keep the clamps on the hose tight.

2. **Starting and Running**

1. When starting an air compressor check the safety valves, pressure valves, and regulators to determine that they are working properly.

2. Do not leave the compressor station after starting the compressor unless it has been made certain that the control, unloading, and governing devices are working properly.

3. Refer to chapter 49, "Compressed Air Plants," *Bureau of Ships Manual*, for starting and testing procedures for air compressors on shipboard.

4. Do not run an air compressor faster than the speed recommended by the manufacturer.

3. **Lubricating**

1. Lubricate air compressors regularly. Use only the proper grade oil as recommended by the manufacturer, and avoid the application of too much oil.

2. *Use only oils which have high flashpoints to lubricate the air cylinders of air compressors.*

4. **Cleaning**

1. Keep compressor, tanks, and accompanying piping clean to guard against oil-vapor explosion. Clean intake air filters periodically.

2. Use only soapy water or suitable non-toxic, nonflammable solution for cleaning compressor intake filters, cylinders, or air passages. Never use benzene, kerosene, or other light oils to clean these portions of a system. These oils vaporize easily and will form a highly explosive mixture under compression.

5. **Adjustment and Repair**

1. Turn off the motor before making adjustments and repairs on an air compressor.

2. Before working on or removing any part of a compressor make certain that the compressor is secured and cannot be started automatically or by accident, that air pressure in the compressor is completely relieved, and that all valves between the compressor and receivers are closed.

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United States Navy
SAFETY PRECAUTIONS

Chapter 7
CONSTRUCTION SITE

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Chapter 7
CONSTRUCTION SITE

Section I
SITE REQUIREMENTS

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07101 SCOPE

These requirements for personnel safety are designed to cover the dangerous conditions ordinarily experienced by personnel engaged in construction and maintenance work at naval shore establishments and advanced bases. The *American Standards Association Safety Code for Building Construction A-10, 2-19* contains additional safety rules for the various fields of activity which constitute the building construction industry. Public works officers and others responsible for the safety of personnel employed on construction and maintenance work should have a current copy of the code and be familiar with its provisions.

07102 DRINKING WATER

1. **Dispensing Methods.** Fresh and pure drinking water shall be supplied on every construction job. Drinking water will be obtained only from sources approved by the public works officer or the officer in charge of construction. Any one of the following dispensing methods shall be used:

1. stationary bubbler with guarded orifice installed on an approved water line;
2. fully enclosed water container and individual paper drinking cups;
3. portable sanitary drinking fountains which meet the specifications of the Procurement Division, Treasury Department.

2. **Containers.** Dipping water out of any container by individual cup, dipper, canteen, or other utensil, is prohibited. Containers must be provided with a covering so designed and fastened as to prevent such use.

3. **Sterilization.** All containers used to furnish drinking water shall be thoroughly sterilized at least once a week, and more frequently if circumstances require, by methods approved by competent medical authorities.

07103 TEMPORARY TOILET FACILITIES

1. **Number Required.** For every 30 persons or less a privy or closet space shall be provided.

2. **Privacy.** It shall be constructed so that the occupant thereof will be shielded from view and protected against the weather and falling objects.

3. **Location.** Privies shall be located so as not to contaminate any domestic water supply used for drinking purposes.

4. **Drainage.** They should be so located and banked that surface water cannot flood the pit.

5. **Trough.** Each privy shall be provided with an adequate urinal trough.

6. **Sewer Connections.** If sewers are available, connections shall be made at once, flush tank closets installed, and running water provided to keep the closet flushed.

7. Pit Latrines. At locations where neither a water carriage sewerage system nor chemical toilet is available, the privy or closet space shall contain a fly-tight box constructed over a pit latrine or over pails, or other suitable containers where pits are impracticable.

8. Sanitary Requirements. Care shall be taken to see that all buildings used as temporary toilets are kept in a clean and sanitary condition. The toilet seats should be scrubbed daily with soap and water, and washed off at least twice a week with an antiseptic solution.

07104 FIRST-AID STATIONS

1. Treatment Facilities. Where medical facilities are not available at a shore establishment a first-aid station or stations, equipped with medicines and supplies common to first aid treatment, shall be established on each project at the beginning of operations and maintained for the duration of the job. On all projects employing fewer than 100 workers, 16-unit first-aid kits shall be provided in the ratio of one for each 25 persons employed and these kits shall be maintained with all the standard medicines and remedies.

2. Reporting Accidents. Workmen shall report all accidents, no matter how trivial. Minor injuries, when neglected, produce most of the infection cases. All injuries shall be given first aid or medical attention immediately. (See article 02202,4.)

3. Qualified Personnel. First-aid care shall be administered under the direction of a qualified first-aid person, a registered nurse, or a licensed physician.

07105 PERSONAL PROTECTION

1. Clothing and Equipment. Chipper's goggles, welder's goggles, welder's shields, hard hats, rubber boots, safety belts, lifelines, life nets, life preservers or jackets, respirators, and other such protective equipment or clothing, occasioned by the type of work being done, shall be made available to employees and their use shall be enforced.

2. Sterilization. Personal protective equipment shall be properly cleaned before being issued to employees.

07106 LIGHTING

1. Where Required. Stairways, corridors, passageways, railroad crossings, excavations, piled materials or obstructions, and working areas shall be kept adequately lighted while work is in progress.

2. When Required. Where working conditions require the use of artificial lighting it shall be maintained after a shift until workmen have had an opportunity to leave the premises.

3. Outdoor Operations. Outdoor operations should be adequately illuminated at night.

07107 GAS AND SMOKE

1. Escaping Gas. No method of heating shall be used which releases smoke or gas within an enclosure where workers are employed.

2. Authorization. No fire or open flame device shall be permitted on a project without the approval of the supervisor or person in charge.

3. Pipes and Stoves. Where smoke pipes from stoves or other heating apparatus pass through combustible walls or roof, proper insulating thimbles shall be provided. All stoves and other heating apparatus shall be mounted on an incombustible base and have proper fire protection at the rear and sides. See *Bureau of Yards and Docks* Publication, "Fire Protection and Fire Prevention."

07108 SALAMANDERS

The use of salamanders is to be discouraged. When they are used, however, constant attention must be given to fires and the following precautions must be strictly observed:

1. Foundation. Salamanders used in buildings shall be installed on a firm foundation and combustible floors shall be properly protected.

2. Cover. Salamanders must be properly covered with a sheet-metal hood and the exhaust piped to the outside air.

3. Clearance. Combustible walls should have at least three feet clearance; where the pipe goes through the roof or walls there shall be a nine inch clearance to combustible material. The use of ventilating thimbles or cold shield pipes is recommended.

4. Used Outdoors. Salamanders used outdoors should be set directly on the ground; they need not be covered.

5. Used in Enclosed Spaces. When salamanders are used in enclosed spaces, proper tests for carbon monoxide should be made and such areas freed of all harmful or toxic gases and fumes before workmen are permitted to enter.

6. Solid Fuel. Only solid fuel salamanders shall be used. The use of oil fuel salamanders is limited to extreme emergency conditions.

7. Moving or Refueling. Oil-fired salamanders when permitted shall be shut down before being moved or refueled.

8. Liquid Fuel. Fires in salamanders shall never be started with gasoline, kerosene, or other flammable liquids.

9. Under Tarpaulins. Where salamanders are used for protection of concrete against freezing and the area is enclosed with tarpaulins or canvas, extreme care is required to prevent contact of salamanders with such enclosure.

07109 ELECTRIC WIRING AND EQUIPMENT

1. General. Temporary electric wiring and equipment shall be installed and maintained by competent and qualified workmen so as to effectively protect all persons against injury therefrom. Permanent installation should be in accordance with the National Electrical Code. See chapter 18 (Electricity and Electronics).

2. Grounding Equipment

a. PORTABLE. All portable electric tools or equipment shall be grounded electrically by means of an insulated flexible ground cable or one of the conductors of a three-conductor extension cord.

b. FIXED INSTALLATIONS. All exposed noncurrent-carrying metal parts of fixed electrical equipment installed under any of the following conditions shall be grounded:

1. when equipment is supplied by means of metal clad wiring;
2. when equipment is located in hazardous, wet, or damp locations;
3. when equipment is located within reach of a person who can make contact with any grounded surface or object;

4. when equipment is within reach of a person standing on the ground;

5. when equipment is in electrical contact with metal;

6. when equipment operates with any terminal at more than 50 volts to ground.

3. Insulation Mats. Suitable insulating mats or platforms of substantial construction providing good footing shall be provided and so placed that the operator or person in the vicinity of machines or equipment having exposed live parts of more than 50 volts, cannot readily touch such parts unless standing on these mats or platforms, or on the insulating floor.

4. Extension Cords. Extension cords of lights and electrically operated tools or devices, together with their connections and fittings, should be of a superior quality. They shall be inspected frequently and be maintained in a safe condition. All extension cords shall be kept dry and free from oil or grease.

5. Switches. Underwriters approved safety-type switches shall be installed for all equipment, and the enclosures shall be grounded.

6. Fuses or Circuit Breakers. All circuits shall be fused or equipped with circuit breakers rated in accordance with the tables of the National Electrical Code. By-passing of circuit breaking devices is prohibited.

7. Deenergizing Circuit. Whenever work of any nature is to be performed on electrical equipment or circuit, all circuits or equipment should be deenergized and grounded. The switch controlling the circuit shall be locked in an open position and tagged to denote that repair work is being performed.

8. Hot Line Work. When workers are required to perform work on circuits which cannot be deenergized, such workers shall be fully qualified to perform hot-line work and they shall be equipped with all necessary safety equipment to guard against the possibility of electrical shock.

9. Explosive Gases. Special fixtures designed for hazardous atmosphere shall be used in locations where explosive gases or dust may be encountered.

10. High Voltage Wiring

a. QUALIFIED PERSONNEL. All work on electric

wiring and equipment carrying high voltage shall be performed by men competent and qualified in high voltage installations.

b. **INSTRUCTION OF PERSONNEL.** Workmen assigned to work on or in close proximity to electrical installations shall be given specific instructions on the work to be performed and the hazards associated therewith.

c. **WARNING SIGNALS.** High voltage lines erected for construction purposes, shall carry appropriate warning signals at all locations where equipment is operated, or where persons may come in close proximity thereto.

d. **WIRING DIAGRAMS.** Wiring diagrams shall be prominently displayed in transformer rooms, switching stations, and other such installations.

e. **TEMPORARY INSTALLATION.** Temporary wiring used in tanks, cofferdams, or other confined spaces shall be equipped with an approved type safety switch for cutting off the current in emergencies and such switch should be located at the entrance to such space. The enclosure of such switch shall be grounded.

07110 HANDLING AND STORING MATERIALS

1. General

a. **STACKING IN TIERS.** All material in bags, containers, or bundles, and other material stored in tiers shall be stacked, blocked, interlocked, and limited in height so that it will be stable and otherwise safe against sliding or collapse.

b. **INSIDE STORING.** Material stored inside buildings under construction shall not be placed within six feet of any hoistway or floor opening, nor on any floor above the ground within ten feet of the outside of the building, unless the exterior walls extend above the top of the storage pile, in which case the minimum distance shall be six feet. Material shall not be stacked against interior columns or roof supports. Floors shall be shored if material stored is heavier than the flooring will support.

c. **PUBLIC THOROUGHFARE STORAGE.** When any material is stored in public thoroughfares, it shall be located so as to present the least possible hazard to the public or interference with traffic.

d. BARRICADES

(1) *Daytime.* The material shall be pro-

tected against being hit or knocked over by trucks or other passing vehicles by means of barricades and red flags during the hours of daylight.

(2) *Night.* The material shall be guarded at night by barricades and an adequate number of red lights located at conspicuous points.

e. **LIFTING.** When handling materials by hand, workmen should always use the leg muscles in lifting, never the back. Help should be obtained, if the load is too heavy or too clumsy to be handled by one man.

2. Piling Lumber

a. **GLOVES.** Men piling lumber shall always wear leather gloves.

b. **TIMBER SILLS.** All lumber shall be piled on timber sills to prevent direct contact between stored lumber and the ground. Sills shall be level and solidly supported.

c. **STACKS.** Lumber shall be so piled as to be safe against falling. The height of the pile shall not exceed 16 feet. The width of piles shall be not less than one-fourth the height. When unpling, each tier shall be completely unpled before beginning another.

d. **CROSS STRIPS.** Cross strips shall be placed in piles which are stacked more than 4 feet high.

e. **PROJECTING NAILS.** Used lumber shall have all projecting nails withdrawn before it is piled, unless it is burned without further handling.

3. Cement and Lime

a. **PROTECTIVE APPAREL.** Men handling cement and lime bags shall wear goggles. They shall always wear snug-fitting neck and wrist bands.

b. **PROTECTION OF SKIN.** Men shall report any susceptibility of their skin to cement and lime burns. They shall make use of a suitable hand cream where its use will prevent burns. They shall always practice personal cleanliness. They shall not wear clothing that has become hard and stiff with cement. Such clothing irritates the skin and may cause serious infection. Men who are allergic to cement and lime should be transferred to other jobs.

c. **HEIGHT OF STACK.** Bags of cement and lime shall not be piled more than 10 bags high except when stored in bins or enclosures built for such purposes.

d. **DIRECTION OF BAG OPENINGS.** The bags around the outside of the piles shall be placed with the mouths of the bags facing the center of the pile.

e. **SETTING-BACK TIERS.** To prevent piled bags from falling outward, the first 5 tiers of bags each way from any corner shall be crosspiled and a set-back made commencing with the sixth tier. If necessary to pile above the tenth tier, another set-back shall be made starting with the eleventh tier.

f. **BACK TIER.** The back tier, when not resting against a wall of sufficient strength to withstand the pressure, should be stepped back one bag every five tiers, the same as the end tiers.

g. **UNPIILING.** During unpiling, the entire top of the pile shall be kept level and the necessary step-backs every 5 tiers maintained.

h. **LIME STORAGE.** Lime shall be stored in a dry place to prevent a premature slaking action that may cause fire.

4. Brick

a. **PILED ON EVEN SURFACE.** Brick shall never be piled on uneven or soft ground but shall always be stacked on planks, except where the surface is of asphalt or concrete.

b. **ON SCAFFOLDS.** Brick shall never be stacked for storage purposes on scaffolds or runways. This shall not prohibit normal supplies on bricklayers' scaffolds during actual bricklaying operations.

c. **HEIGHT OF PILES.** Except where stacked in sheds, brick piles shall never be more than 7 feet high.

d. **TAPERING THE STACK.** When a pile of brick reaches a height of 4 feet it shall be tapered back 1 inch in every foot of height above the 4 foot level.

e. **UNPIILING.** The tops of brick piles shall be kept level and the taper maintained during un-piling operations.

5. Masonry Block and Hollow Tile

a. **LEVEL SURFACES.** Blocks shall always be stacked in tiers on solid, level surfaces.

b. **HEIGHT OF STACKS.** Stacked piles shall be limited to a height of 6 feet whenever possible. When blocks are stacked higher than 6 feet the pile shall be stepped back, braced, and propped, or wood strips placed between tiers to prevent the pile from toppling.

c. **LOWERING BLOCKS.** Blocks shall not be dropped or thrown from an elevation or delivered through fully enclosed chutes.

6. Reinforcing and Structural Steel

a. **GLOVES.** Men handling reinforcing steel shall wear leather gloves.

b. **BENDING STEEL.** Bending of reinforcing steel on the job shall be done on substantial benches secured against tipping. Benches shall be located on nonslippery level surfaces.

c. **PIILING STEEL.** Structural steel shall be carefully piled to prevent sliding or tipping over. If there is danger of tipping over, I-beams shall be stored with webs horizontal.

7. **Corrugated and Flat Iron.** Corrugated and flat iron shall be stacked in piles not more than 4 feet high. Spacing strips shall be placed between bundles. On permanent installations, this material may be stacked vertically or at a slight incline to the vertical, provided such stacking is in substantial racks of steel or concrete of an approved design.

8. Pipe

a. **TO PREVENT SPREADING.** Pipe of all kinds shall be stacked in such a way as to prevent the stack from spreading.

b. **APPROACH FROM END OF PILE.** In removing pipe larger than two inches in diameter from storage piles in which the pipes all run in the same direction and more than one pipe high, employees shall approach the pile from the ends and not from the sides.

c. **SIZE OF PILE.** If piled, sewer pipe shall be segregated by sizes, and the height of any pile shall not exceed 5 feet.

9. Sand, Gravel, and Crushed Stone

a. **OVERHANG.** In withdrawing sand, gravel, and crushed stone from frozen stock piles, no overhang shall be permitted to exist at any time.

b. **PROTECTION OF WALLS.** Material should not be dumped against walls or partitions. When this must be done, it shall not be stored to a height that will endanger the stability of such walls and partitions.

c. **LIFELINES.** When men are required to work in hoppers or on high piles of loose material they should be equipped with safety belts and lifelines having no more than 2 feet of slack.

07111 LADDERS**1. Specifications**

a. SAFETY CODE. Commercially manufactured ladders shall comply with the specifications currently in use by the Department of the Navy.

b. DEFECTIVE PARTS. Ladders should be inspected at frequent regular intervals. Ladders with weakened, broken, or missing treads, rungs, or cleats, or broken or "splintered" side rails shall not be used. Ladders which have developed defects affecting their strength should be withdrawn from service.

c. COATING. Ladders should be kept coated with a suitable protective material. Ladders may be treated with linseed oil or coated with a clear shellac or other transparent material. Painting with opaque paint is forbidden.

d. FOR TWO-WAY TRAFFIC

(1) *Two Ladders.* Separate ladders for ascending and descending shall be provided in building construction of more than 2 stories in height, or where traffic is heavy.

(2) *Single Ladders.* Where it is necessary to install a ladder wide enough to permit traffic in both directions at the same time, a center rail shall be provided. One side of the ladder should be plainly marked "up" and the other side "down".

e. GUARD RAILS. Ladders used in passageways, driveways, or public thoroughfares shall be guarded by barricades (guardrails). Doors which open adjacent to portable ladders should be locked or otherwise blocked or guarded while the ladder remains in use.

2. Position

a. SUPPORT. Ladders shall be placed so that the rails have a secure footing and a substantial support at or near the top.

b. STABLE POSITION. Ladders shall not be placed against sash, windowpanes, or unstable supports such as loose boxes or barrels. The use of ladders during a storm or in a high wind shall be avoided unless absolutely necessary, in which case the ladder shall be securely lashed in position.

c. AGAINST WINDOW FRAMES. If a ladder is to

be placed against a window frame, a board shall first be spiked across the side rails at the top.

d. IN FRONT OF DOOR. A ladder shall never be placed in front of a door opening toward the ladder unless the door is locked, or otherwise blocked, barricaded, or guarded.

e. IN ELEVATOR SHAFTS. Ladders shall not be placed or used in elevator shafts or hoistways. Should such a procedure be necessary, the ladders shall be protected from objects falling from operations at higher elevations in or adjoining the shaft.

f. STANDING OUTSIDE. Ladders shall not be left standing, especially on the outside, for long periods of time unless securely anchored at both top and bottom to prevent falling in case of sudden wind storms.

g. LOWERING LADDERS. Ladders should be handled carefully when being lowered. They should not be allowed to drop on their sides or to fall heavily endwise on one rail.

h. NEAR ELECTRIC CIRCUITS. Ladders used near live electric circuits should not have metal rungs, braces, trusses, or struts, because of the danger of short circuits or accidental contact with the live wires.

3. Use

a. CAUSE OF ACCIDENTS. The use of ladders where scaffolds, platforms, or other substantial working levels should have been provided, has resulted in many serious accidents. Work performed from ladders should be kept to a minimum.

b. FACING LADDER. When ascending or descending a ladder, the user shall always face the ladder.

c. FREE HANDS. No one should go up or down a ladder without the free use of both hands. If material must be handled, a rope should be used.

d. RUNNING. No one shall run up or down a ladder, or slide down a ladder, at any time.

e. GREASE ON SHOES. Before attempting to climb a ladder, workmen should remove oil or grease from the soles of their shoes.

f. SAFETY BELT. When doing maintenance work above the ground, workmen should always use a safety belt, with a lifeline tied off long enough for necessary movement, but short enough to prevent falls.

4. Single Portable Ladders

a. **DEFINITION.** A single portable ladder is a ladder of one section which may be used at various locations.

b. **LENGTH.** Single portable ladders over 30 feet in length shall not be used.

c. **ANGLE.** When a portable ladder is placed against the wall or other fixed object, unless the ladder is securely fastened or a man is holding it, the base should be one-fourth the ladder length from the vertical plane of the top support. Where the rails extend above the top landing, ladder length to the top support only is considered.

d. **BACK CLEARANCE.** The clearance back of a ladder should always be sufficient to obtain a secure foothold on the rungs. Clearance of at least 6 inches is recommended.

e. **FRONT CLEARANCE.** The clearance space in front of the ladder should be such that it will not be necessary to assume a cramped or unnatural position when climbing. Front clearance of at least 30 inches is recommended.

f. **NONSLIPPING BASE.** Portable ladders, where used on smooth floors or sloping surfaces, should be equipped with nonslipping bases, or otherwise secured to prevent displacement.

g. **SPICING.** Single ladders which were not constructed to be used as sectional ladders should not be spliced together to form a longer ladder, unless such splicing together will provide and maintain the strength and rigidity required for a longer ladder.

5. Fixed Ladders

a. **DEFINITION.** A fixed ladder is a ladder fastened to a structure in a permanent position.

b. **FASTENINGS.** Fixed ladders shall be securely held in place by top, bottom, and intermediate fastenings as required.

c. **CLEARANCE.** Vertical ladders shall have a clear distance of at least 6½ inches from back of the rung or cleat to the nearest permanent object. Climbing clearance should be at least 30 inches from face of rungs to the nearest obstruction.

d. **SLOPING LADDERS.** Sloping ladders which require climbing on the under side of the ladder shall not be used.

e. **LANDING PLATFORMS.** Rails of ladders fixed to top landings should extend a distance of at

least 36 inches above the landing. Rungs above the landing shall be omitted when it is necessary to pass through the ladder. Landing platforms shall be provided where a person must step a greater distance than 14 inches from ladder to roof, tank, etc.

f. **PLATFORM INTERVALS.** Landing platforms shall be provided for fixed ladders exceeding 30 feet in length at intervals of 30 feet or fraction thereof. The ladder sections shall be offset each from the other and connected by a landing platform. The top rung of any section of fixed ladder shall be at the level of or above the adjacent landing platform. On stacks or tanks the offset provision need not apply.

g. **METAL CAGES.** Metal cages extending from a point 7 feet above the base should be provided for all permanently fixed external and internal ladders more than 20 feet in height where such ladders are employed in regular service.

6. Extension Ladders

a. **DEFINITION.** An extension ladder is a ladder consisting of two or more sections traveling in guides or brackets so arranged that it may be adjusted to different lengths.

b. **SPECIFICATIONS.** Extension ladders shall not have more than two sliding sections. No extension ladder exceeding 60 feet in length when extended shall be used.

c. **ANGLE.** Extension ladders should be raised vertically, locked, and then placed at the same angle as single ladders. (See 07111-4c).

d. **OVERLAPPING PORTIONS.** Extension ladders shall be so constructed that, when locked in any position, rungs of the overlapping portions of each section will be opposite each other and of strength equal to a ladder with continuous side rails.

e. **EXTENT OF OVERLAP.** A lap of 3 feet shall be maintained for ladders up to 38 feet of extension length; 4 feet for ladders 38 to 44 feet; and 5 feet of lap for ladders 44 feet of extension length.

7. Stepladders

a. **DEFINITION.** A stepladder is a ladder having treads and so constructed as to be self-supporting.

b. **LENGTH.** Stepladders longer than 16 feet shall not be used.

c. FULLY OPEN. Stepladders shall be fully opened before anyone steps on them.

d. USED AS PLATFORM. A stepladder shall not be used as a working platform.

e. TOOLS. Tools shall not be left on top of stepladders, unless tool holders are provided.

f. STRENUOUS ACTION. Stepladders shall not be used when strenuous action on the part of the workmen is required. Under those circumstances there is danger of turning the ladder over.

8. Sectional Ladders

a. DEFINITION. A sectional ladder is a ladder consisting of two or more sections so constructed that the sections, when combined, will function as a single ladder.

b. SPECIFICATIONS

1. Sectional ladders longer than 30 feet shall not be used.
2. The bottom and intermediate sections of sectional ladders should not exceed a length of $6\frac{1}{2}$ feet, and the top section should not exceed a length of 9 feet.
3. The connection joint of sectional ladders shall not be less than 1 foot and shall fit closely without binding or unnecessary play.

c. ANGLE. Sectional ladders shall be placed for use at the same angle as single ladders. (See 077111-4c).

9. Trestle Ladders and Extension Trestle Ladders

a. DEFINITIONS

(1) *Trestle Ladder.* One consisting of two single ladders hinged at the top to form equal angles.

(2) *Extension Trestle Ladder.* One consisting of a trestle ladder with an additional single ladder which is adjustable vertically and provided with a lock to keep it in place.

b. DIMENSIONS PERMISSIBLE. Trestle ladders and the base sections of extension trestle ladders shall be limited to 20 feet in height. The extension section of extension trestle ladders shall not exceed 20 feet.

c. SUPPORT FOR SCAFFOLD. Trestle and extension trestle ladders shall be so spread that the width of the trestle at the bottom, inside to inside, is equal to or greater than $5\frac{1}{2}$ inches per foot of ladder length.

d. LOCKING DEVICE. The locking device or spreader used to hold the front and back sections securely in an open position and each pair of side rails rigidly parallel to one another must always be secured in its place when using the extension ladder. Also, the locking device for securing the extension section to the base must be utilized.

07112 WHEELBARROWS

1. Handles. Wheelbarrows with cracked or broken handles shall not be used.

2. Wheels. Twisted and out-of-round wheels shall be repaired or discarded.

3. Knuckle Guards. When wheelbarrows are used in narrow passageways, gloves or knuckle guards should be used.

4. Balancing Load. Wheelbarrow loads shall be balanced carefully with the center of the weight placed well forward to save lifting strain.

5. Lifting With Leg Muscles. When picking up a loaded wheelbarrow, the knees should be bent and the lifting done with the leg muscles.

6. Pulling Prohibited. Wheelbarrows should always be pushed, *not pulled*.

7. Running. Workmen shall never run with empty wheelbarrows in an upright position. This practice leads to serious injury from stumbling and falling.

8. Overloading. Wheelbarrows should not be overloaded, especially when used on ramps.

9. Leaving in Hazardous Spot. Wheelbarrows shall never be left in such a position that they can readily tip over or fall and shall never be left where persons or traffic can run into them.

Section 2

FLAMMABLE LIQUIDS AND FIRE PREVENTION

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Instruction of Personnel, 07202
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07201 DEFINITION

Flammable liquids as referred to herein include any gaseous, vaporous, or liquid substance which is easily ignited, having a flash point at or below 80° F. This includes a variety of volatile liquids, such as gasoline, ether, liquid petroleum gas, naphtha, benzol, alcohol, kerosene, fuel oil, turpentine, paints, varnishes, lacquers, driers, and cleaning solutions.

07202 INSTRUCTION OF PERSONNEL

1. **District Fire Officer.** A reliable individual shall be assigned the responsibility of seeing that proper fire prevention and fire protection measures are taken throughout the life of each construction project. This person should obtain instruction and professional advice from the District Fire Officer covering the proper measures to be taken in the particular project. *Bureau of Yard and Docks* Publication, "Fire Protection and Fire Prevention," shall be used as a guide.

2. **Posters and Signs.** Regardless of the size of the job, steps should be taken at the start to impress workmen that each particular project is to be a safe one, with no added dangers of fire. This can usually be best accomplished through the use of posters and signs placed in prominent places around the job.

3. **Smoking.** Prohibition of smoking may be necessary for the entire job, or only for certain parts of it. However, "NO SMOKING" signs

shall always be posted in areas where hazardous materials are stored, and the rule must be strictly enforced. *Carelessness in the disposal of smokers' materials, matches, etc. is one of the major causes of fires.*

4. **Flame Producing Devices.** The carrying of pocket lighters containing flammable liquids, special spark-producing devices, and matches by personnel regularly engaged in flammable fuel handling operations is prohibited.

5. **Handling Flammable Liquids.** All storage, handling, or use of flammable liquids shall be under the supervision of qualified persons. No one shall be permitted to handle or use flammable liquids until he has been instructed in their safe handling and use.

6. **Sources of Ignition.** All recognized sources of ignition shall be prohibited in areas where flammable liquids are stored or handled.

7. **Inspection.** A weekly inspection shall be made of all systems and equipment used for the storage and handling of flammable liquids.

07203 FIRE PREVENTION, GENERAL

1. **Reporting Fires.** A rule of primary importance which should be impressed upon every construction worker is: "ALWAYS CALL THE FIRE DEPARTMENT FIRST". On small jobs the workmen should use the nearest fire alarm box or the nearest telephone. On the larger construction jobs it is desirable to have a small force of paid men who can make inspections, keep fire equipment in good condition,

and quickly respond to fire calls. See *Bureau of Yards and Docks* Technical Publication TP-PU-4, "Fire Prevention and Fire Protection."

2. Fire on Construction Projects. No fire shall be permitted on the construction project without the approval of the supervisor or officer in charge.

3. Fire Blankets. Woolen or asbestos fire blankets shall be provided and kept in conspicuous and easily accessible locations where substantial quantities of flammables are stored, handled, or used. Safety showers should be made available in such locations whenever practical.

4. Exhaust Systems. All buildings, rooms, and compartments where flammables are present shall be properly ventilated. Where mechanical ventilation or exhaust systems are necessary, they shall be in accordance with the requirements of the National Board of Fire Underwriters.

5. Fire Extinguishers. Approved type fire extinguishers shall be provided at all locations where flammable liquids are stored or used.

6. Recharging Fire Extinguishers. The Fire Chief shall always be notified whenever a fire extinguisher has been used, so that arrangements can be made to have it recharged.

7. Welding and Cutting. Whenever welding and cutting operations are being carried on in the vicinity of oil and other flammable material, "DANGER" and other warning signs and posters shall be prominently displayed. Fires, open flame devices, burning, welding, and cutting operations conducted near combustible materials, shall never be left unattended. Fire extinguishers of proper type shall be provided at the immediate location. The Fire Chief shall inspect areas and determine the need for a stand-by fire watch. See article 11103,5.

8. Stacking Combustible Material. A clearance of at least 25 feet from buildings or structures should be maintained for piles of lumber and other materials to be used in construction.

9. Lighting. Electric lighting shall be the only means used for illumination in areas where flammable liquids, vapor, fumes, dusts, or gases are present. All electrical equipment and installations shall be in accordance with provisions of the National Electrical Code for

Class 1 locations. Lighting fixtures of the explosion-proof type shall not be disassembled or lamps replaced until it is certain that the circuit is dead.

10. Heating Systems. Heating systems in buildings where flammable liquids are stored or processed shall be installed in accordance with regulations of the National Board of Fire Underwriters.

11. Salamanders. Salamanders utilized in job offices, storage sheds, or in other buildings under construction shall be installed and used in strict accordance with the precautions given in article 07108 of this chapter.

07204 REFUSE

1. Prescribed Areas. Definite areas should be set aside for the dumping of refuse materials, and signs provided to direct attention to these areas.

2. Daily Clearance. All refuse should be cleared from buildings daily.

3. Rubbish. Rubbish, brush, long grass, or other combustible material shall not be allowed to accumulate near areas in which flammables are stored.

4. Waste Cans. All flammable waste materials, such as oil, paint, chemical-soaked rags, or clothing, shall be deposited in self-closing waste cans. Highly flammable liquids shall be kept in approved safety cans bearing Underwriters Laboratories label, and should not be stored in quantities lest they become serious fire hazards.

5. Spills. All spills of flammable liquids shall be cleaned up immediately.

07205 CONTAINERS AND TANKS

1. Approved Types. All flammables, including intrastate shipments, shall be in containers approved for shipment of such materials and tagged or labeled in accordance with regulations of the Interstate Commerce Commission. All tanks, containers, and pumping equipment, portable or stationary, used for the storage or handling of flammables should meet the requirements of the National Board of Fire Underwriters.

2. Open Flame Dangerous. An open flame shall

never be used when looking into openings of tanks or other containers that have contained explosives or flammable substances. Flashlights and electric lanterns used in connection with these containers shall be as approved by the Underwriters Laboratories, Inc. for explosive atmospheres.

3. Bungs and Stoppers. Bungs, caps, or stoppers shall not be left out of drums, barrels, or other flammable liquid containers. This rule also applies to empty containers.

4. Grounding. All tanks, hose, and containers shall be kept in constant metallic contact with ground while flammable liquids are being poured, to prevent static electricity discharges.

5. Purging Gas Tanks. No person shall be permitted to enter a storage tank, tank car, or other vessel which has contained flammables until such vessel has been properly purged and ventilated. An attendant shall be stationed at the entrance to such tank or vessel. After purging and ventilating, a test shall be made for gas. If the vessel is not gas free, purging and ventilating shall be repeated. In the case of large gasoline tanks having a layer of sludge at their bottom, the test for gas should be made continuously so long as a workman remains in the tank.

07206 CLEANING CONTAINERS

1. Approved Procedures. The cleaning of petroleum storage tanks must always be done in strict accordance with the standards of American Petroleum Institute as contained in their Accident Prevention Manual Nos. 1A and 1B.

2. Personal Protection. All persons entering storage tanks, tank cars, or other vessels which have contained flammable liquids or gases shall be provided with necessary protective clothing, approved air-fed masks, safety belts, and lifelines. Where tanks have contained leaded gasoline, protective gloves should always be issued as well as other protective clothing.

3. Welding and Cutting. No welding, cutting, riveting, or other hot work and no mechanical repairs shall be performed on a storage tank or other vessel which has contained flammable liquids until such vessel has been properly purged and ventilated. The proper equip-

ment including fresh-air hose masks, suitable clothing, safety belts, safety lines, and non-sparking tools must be used for this work. (See chapter 11, section 6).

4. Flash Point of Cleaner. No solvent with a flash point below 100° F. shall be used for the cleaning of equipment parts. Wherever possible nonflammable or water-solvent detergents should be used for cleaning.

07207 STORAGE OF FLAMMABLE LIQUIDS

1. Regulations. Storage of flammable liquids shall be in accordance with the regulations of the National Board of Fire Underwriters.

2. Vents. All storage tanks shall be equipped with proper relief vents. Tank vents shall not be located close to open flames, stacks, heating apparatus, or any other source of ignition. Vent screens shall be inspected daily.

3. Freezing of Valves. Water draw-off valves shall be insulated to prevent freezing.

4. Berms, Dikes, or Curbs. All storage tanks above ground shall be diked, curbed, or other suitable means provided to prevent the spread of liquids to other property in case of a rupture in tank or piping. Such dike or curbed area shall have a capacity greater in volume than that of the tank. Large quantities of flammable liquids should have an adequate clear space between them and nearby structures or other tanks.

5. Fire-Resistant Structure. Indoor storage of large quantities of flammable liquids or gases in drums or other containers should be in a separate fire-resistant building located at least 80 feet from nearest buildings or structures.

6. Locked Buildings. Entrances to storage or process buildings shall be kept under lock and key. Only authorized persons shall be permitted to enter such buildings.

7. Restriction on Amounts. A ventilated metal cabinet shall be provided for the storage of more than a total of 10 gallons of oil, varnishes, paints, and lacquers in buildings used for other than storage or processing. Not more than a total of 50 gallons shall be stored in any one cabinet. No individual container shall exceed 5 gallons capacity.

8. Day's Supply. Not more than one day's sup-

ply of flammable liquids shall be kept in any processing or mixing room. If one day's requirement amounts to more than 55 gallons, not more than one drum shall be permitted in the room at one time.

07208 HANDLING FLAMMABLE LIQUIDS

1. Dispensing. All dispensing of flammable liquids from tank trucks or underground tanks shall be done by an approved pumping or water displacement system. This rule applies to containers of over 55 gallons capacity. Gasoline drums when used as dispensers, shall be equipped with drum pumps of approved type.

2. Open Containers. The handling of flammable liquids in open containers is prohibited. Approved safety cans shall be used for gasoline and other solvents.

3. Spotting. Tank cars or trucks shall be spotted accurately and not loaded or unloaded

until the brakes have been set and the wheels chocked.

4. Warning Signals. Blue flag warning signs shall be clamped to the rails to warn train crews when tank cars are connected.

5. Leaving Unattended. Tank cars shall never be left unattended while being loaded or unloaded.

6. Bonding Tanks. All tank cars and trucks shall be properly bonded before being loaded or unloaded. Bonding connections shall be made before dome covers are removed in cars and trucks and shall not be disconnected until such covers have been replaced. Internal vapor pressure shall be relieved before the dome covers are opened.

7. Overflow. Fuel tank filler openings shall not be located in such a position that spills or overflows can run down onto a hot motor or other source of ignition.

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United States Navy
SAFETY PRECAUTIONS

Chapter 8
DEMOLITION, CLEARING, AND EXCAVATION

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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08101 GENERAL

1. **Regulations and Codes.** Where applicable, federal, state, and local codes, rules, regulations, and ordinances governing any and all phases of demolition work shall be observed at all times. The safety precautions herein stated apply wherever demolition by the piece-by-piece method is undertaken.

2. **Overloading.** No structure, or part of a structure, of any floor or temporary support, or scaffold, sidewalk, shed, or bridge, or any device or piece of equipment shall be loaded in excess of its safe carrying capacity.

3. **Walkways.** Walkways and passageways shall be provided for the use of the workmen, who shall be instructed in their use. All such walkways and passageways shall be kept adequately lighted and free from debris and other materials.

4. **Protruding Nails.** Protruding nails in any kind of lumber shall be withdrawn, hammered in, or bent over as soon as such lumber is removed from the structure being demolished; or all nail-bearing lumber shall be placed in piles for future cleaning or burning.

5. **Dust.** During the demolition operation, the work shall be sprinkled regularly to keep the dust to a minimum.

6. **Protective Apparel.** Gloves should be worn. All workmen exposed to the danger of falling objects shall wear hard hats.

7. **Goggles.** Approved type safety goggles shall be worn to protect the eyes against injury from flying pieces and from dirt and dust blown by the wind. Workers using jack hammers shall wear goggles having strength-tested lenses and conforming to the requirements in Navy Department specifications, 37-G 17, "Goggles, eye-cup, chippers."

8. **Respirators.** If the operations are dusty these workers shall also wear respirators in accordance with Navy specifications.

9. **Protective Equipment.** Only Navy approved personal protective equipment as described and illustrated in the U.S. Navy Manual of Safety Equipment, NavExos, P-422, is authorized.

08102 WARNING SIGNS AND LIGHTS

1. **Dangerous Areas.** On every demolition job, *danger* signs shall be conspicuously posted around the property; all doorways or thoroughfares giving access to the property shall be kept barricaded except during the actual passage of men or equipment.

2. **Barricades.** Exterior wall openings which extend down to floor level shall be barricaded to a height not less than 3 feet above floor level when the debris requires such action.

3. **Guard Rails.** Floor openings and shafts not used for material chutes or workers' entrances shall be floored over or enclosed with guard-rails and toe boards.

4. Flares. During the hours of darkness, red lights, flares, reflectors, or fluorescent warning devices shall be placed on or about all barricades.

5. Watchmen. When operations are not in progress, a watchman or watchmen shall be stationed to prevent the public from entering the danger zone and to maintain all danger signs, lights, and barricades.

08103 PREPARATION OF LOCATION

1. Electric Power. The power on all electric service lines shall be shut off and all such lines shall be cut or disconnected at or outside the limits of the site before demolition work is started. Prior to the cutting of such lines, the approval or cooperation of the local electric service company shall be obtained.

2. Gas Service. Before starting demolition work, gas service shall be cut off and gas lines capped, with the approval or cooperation of the local gas service company.

3. Protection of Power Lines. If it is necessary to maintain power, water, steam, or other lines during demolition, such lines shall be temporarily relocated or protected with substantial covering to the satisfaction of the local utility companies and in accordance with codes and legal requirements.

4. Glass. Glazed sash and glazed doors and other glass fixtures shall be removed before other demolition work is started.

5. Shoring. If a structure to be demolished is considered to be insecure, the walls shall be shored or braced in accordance with the requirements of the authorities having jurisdiction, or in the absence of such requirements, in accordance with accepted engineering practice, before any demolition work is started.

08104 SIDEWALK SHEDS

1. Public Thoroughfares. Before any demolition work is commenced, every sidewalk or public thoroughfare adjacent to the work site shall either be closed or protected as specified elsewhere in this section. Such thoroughfares which are open to the public shall be kept clear and unobstructed at all times.

2. When Required. If a structure to be de-

molished is more than 2 stories or 25 feet high, measured from sidewalk or (if there is no sidewalk) from the street level, and if the horizontal distance from the inside of the sidewalk to the structure is 15 feet or less, a substantial sidewalk shed shall be constructed over the entire length of the sidewalk adjacent to the structure, of sufficient width to accommodate pedestrian traffic without causing congestion.

3. Lighting. Sidewalk sheds shall be lighted either by natural or artificial means sufficient to ensure safety at all times.

4. Load Capacity. Every sidewalk shed shall be capable of safely sustaining a minimum load of 150 pounds per square foot, and if material is to be stored thereon, the shed shall be capable of sustaining the load to be imposed.

5. Fencing. Unless the top deck of the sidewalk shed is built solidly against the face of the structure to be demolished, the vertical face of the shed supports next to the building shall be solidly fenced throughout. This shall not prohibit the construction and use of such solid sliding or swinging gates as may be necessary for the prosecution of the work.

6. Enclosing Roof. The outside edge and ends of the roof of the shed shall be provided with a substantial enclosure of at least 42 inches above the shed. Such enclosures may be vertical or inclined outward at approximately 45 degrees and shall consist of boards laid close together secured to braced uprights, or toe boards and galvanized wire netting formed of not less than No. 16 U.S. gage wire and one and one-half inch mesh.

7. Loading Passages. Sidewalk shed openings for loading purposes shall be kept closed at all times except during actual loading operations.

8. Specifications for Shed Roof. The roof of a sidewalk shed shall consist of planking not less than 2 inches in thickness, closely laid, and shall be made watertight through the use of tar paper roofing or similar material. All members of the shed shall be adequately braced and connected to resist displacement of members or distortion of the framework.

9. Fences. When the horizontal distance from the inside of the sidewalk to the structure is more than 15 feet but less than 25 feet, a substantial fence may be constructed along the in-

side of the walk in lieu of a sidewalk shed. If it has been permitted to close the sidewalk, the fence may be constructed along the inside edge of the roadway. The fence shall be at least 6 feet high of wood or other suitable material, and shall be built solid for its entire height and length except that openings necessary for the proper prosecution of the work may be provided with solid sliding or swinging gates.

10. Railings. When the horizontal distance from the inside of the sidewalk to the structure is more than 25 feet, it is permissible to construct a substantial railing in lieu of a fence on the inside of the walk or roadway, with the necessary access gates. If permission has been granted to close the sidewalk, the railing may be constructed along the inside edge of the roadway.

11. Canopies. Where workers' entrances to buildings being demolished are not completely protected by sidewalk sheds, all such entrances shall be protected by canopies extending from the face of the building to a point not less than 8 feet from it. In each case such overhead protection shall be at least 2 feet wider than the building entrance or opening and every canopy shall be at least as strong as the sidewalk shed described in paragraph 8 of this article.

08105 REMOVAL OF MATERIALS

1. Gloves. Workmen removing materials shall wear leather gloves.

2. Dropping Material. No material shall be dropped to any point lying outside the exterior walls of the building except through enclosed wooden or metal chutes.

3. Enclosing Chutes. All material chutes which are at an angle of more than 45 degrees from the horizontal shall be entirely enclosed on all four sides except for openings at or about floor level for the receiving of materials.

4. Specifications for Chutes. Openings as specified in rule 3 shall not exceed 48 inches in height measured along the wall of the chute, and in all stories below the top floor such openings shall be kept closed when not in use.

5. Angle of Chute. Chutes at an angle of less than 45 degrees with the horizontal may be left open on the upper side, provided that at the

point where such a chute discharges into a chute steeper than 45 degrees with the horizontal, the upper side of the steeper chute is boarded over to prevent the escape of material.

6. Gate at Chute. A strong gate shall be installed in each chute at or near the discharge end and a reliable employee shall be designated to control the gate and the backing up and loading of trucks.

7. Protection of Passersby. A designated employee shall be instructed to prevent any person from standing or passing under the discharge end of the chute.

8. Guarding Chute

a. BOTTOM. When operations are not in progress, the danger area at the discharge end of each chute shall be completely enclosed with a substantial fence, or otherwise made inaccessible.

b. TOP. Chute openings into which workmen dump debris shall be guarded by a substantial guard rail extending at least 36 inches above the level of the floor or other surface on which men stand to dump material into chutes.

08106 STAIRS, PASSAGEWAYS, AND LADDERS

1. Access to Building. With the exception of stairways, passageways, and ladders for the use of workmen, access to the building being demolished shall be entirely closed off at all times.

2. Securing Ladders. All ladders shall be secured against slipping out at the bottom, and against movement of any kind at the top.

3. Safe Condition. All stairs, passageways, and ladders used by workmen shall be maintained in a safe condition. (See 07111 for special precautions concerning the specifications for and use of ladders).

08107 REMOVAL OF WALLS

1. Order of Demolition. Except for the cutting of holes in floors for chutes and holes through which to drop materials, the preparation of storage space, and other necessary preparatory work, demolition of exterior walls and floor construction shall begin at the top of the structure and proceed downward, and each story of exterior wall and floor construction shall be removed and dropped into the storage space before

commencing the removal of walls and floors in the story next below. This requirement shall not prohibit the demolition of a structure in vertical sections so long as positive means are taken to prevent injury to persons or damage to property.

2. Overloading Floors. Masonry walls or other sections of masonry shall not be permitted to fall upon the floors of the building in masses that exceed the safe carrying capacity of the floors.

3. Lateral Bracing. No section of wall whose height is more than 22 times its thickness shall be permitted to stand without lateral bracing unless such wall is in good condition and was originally designed to stand to a greater height without such lateral support.

4. Hazardous Weather. Workmen shall not be permitted to work on top of a wall when weather conditions constitute a hazard.

5. Load-Supporting Members. Structural or load-supporting members on any floor shall not be cut or removed until all stories above that floor have been demolished and removed. This provision shall not prohibit the cutting of floor beams for the purpose of removal of materials, stated in paragraph 08105, or for the installation of equipment; nor shall it prohibit the removal of intermediate steel floor beams not required for the stability of the structure.

6. Openings in Floor. Before demolishing any interior or exterior wall which is within 10 feet of any opening in the floor immediately below, such opening shall be substantially planked over unless all workmen are removed from all floors below and access to such floors is positively prevented.

7. Steel Framing. In buildings of "skeleton" construction, the steel framing may be left in place during the demolition of masonry work. Where this is done, steel beams, girders, and the like shall be cleared of all loose material as the masonry work progresses downward.

8. Walkways. Walkways shall be provided to enable workmen to reach or leave their work on any scaffold or wall. Such walkways shall be not less than three planks, nor less than 30 inches wide.

9. Stability of Remaining Walls. At the completion of each day's work, all walls shall be left stable and in no danger of being overturned.

08108 CATCH PLATFORMS

1. Where Used. During the demolition of the exterior walls of a structure originally more than 70 feet high, catch platforms shall be erected along the exterior faces of such walls where necessary to prevent injury to the public and to men working below.

2. Three-Story Limit. Such catch platforms shall be constructed and maintained not more than three stories below the story from which the exterior walls are being removed. When the demolition has progressed to within three stories of ground level, catch platforms will not be considered necessary.

3. Limitation of Use. Materials shall not be dumped on catch platforms nor shall such platforms be used for the storage of materials.

08109 REMOVAL OF FLOORS

1. Definition. In the following rules the term "floor arches" shall apply to the masonry filling between the floor beams and girders irrespective of the type of floor system.

2. Width of Section. In cutting holes in floor arches which span in one direction between two beams or supports, the section of floor arch to be removed in making such hole may be of any width and shall include the entire span of the floor arch which is between the two beams or supports on which it bears.

3. Supporting Planks. When workmen are engaged in removing floors, planks of ample strength (not less than 2 inches thick by 10 inches wide) shall be provided and used by workmen breaking down floor arches. The planks shall be so placed as to give the workmen firm support should the arch collapse unexpectedly. If it is necessary for a workman to straddle a space between two planks, such space shall not exceed 16 inches.

4. Walkways. Walkways not less than 30 inches wide formed of planks of ample strength (not less than 2 inches thick by 10 inches wide) shall be provided and used by the workmen when necessary to enable them to reach any work place without walking on exposed beams.

5. Stringers. Stringers of ample strength shall be installed to support the planks where necessary and the ends of such stringers shall be sup-

ported by floor beams or girders and not by floor arches alone.

6. Barricades. When floor arches are being removed, no workmen shall work in the area directly underneath and such area shall be barricaded to prevent access to it.

7. Clearing Floor Area. The demolition of floor arches shall not be started until they and the surrounding floor area for a distance of 20 feet have been entirely cleared of debris and other unnecessary material.

08110 DEMOLITION OF STEEL CONSTRUCTION

1. Planking Derrick-Supporting Beams. When floor arches have been removed, the entire tier of beams on which any derrick is supported shall be completely planked over except for such openings as are required for handling material or equipment.

2. Signal System. In the operation of cranes and derricks, a standard signal system shall be used and all men assigned to the operation of

such equipment shall be fully instructed in the proper use of these signals.

3. Tag Lines. A tag line or guide rope should be used on all hoisted or lowered loads.

4. Riding Load. The riding of the load line in any lifting device is prohibited.

5. Protection of Eyes. Where it is necessary to do any burning with acetylene, welders' goggles of approved type (paragraph 11122) shall be worn by the workmen so engaged.

6. Lifting Acetylene or Oxygen Tanks. Whenever acetylene or oxygen cylinders are transported or lifted by crane or derrick, such cylinders shall be placed in substantial stands or cradles in an upright position.

7. Swinging Beams. No beam shall be cut until precautions have been taken to prevent it from swinging freely and possibly striking any worker or any piece of equipment or any part of the structure being demolished.

8. Lowering Steel. All structural steel shall be lowered from the building; it shall never be allowed to drop.

Section 2

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08201 GENERAL

1. Trained Personnel. The handling, storage, and use of explosives shall be directed by persons of proved experience and ability in blasting operations, and shall conform with Bureau of Ordnance and station regulations and with the requirements of state and municipal authorities having jurisdiction. Precautions for transportation of explosives will be found in 04215. Rough handling, careless stowage, and similar improper treatment of explosives can lead to serious explosions and accidents. Supervisory personnel engaged in or responsible for blasting operations should be familiar with the practices described in *The Blaster's Handbook*, published by E. I. duPont de Nemours and Co., Inc.

2. Use of Intoxicants. No person addicted to the use of, or under the influence of intoxicants or narcotics shall transport, handle, stow, or otherwise use explosives.

3. Smoking. Personnel actively engaged in the transportation, handling, stowage, or use of explosives shall not smoke or carry matches, cigarette lighters, or other flame-producing devices on their person or in a vehicle containing explosives.

4. Personnel Kept to a Minimum. The number of personnel engaged in handling explosives and the number present in the vicinity of the place where explosives are in use shall always be kept to a minimum.

08202 STOWAGE AND HANDLING OF EXPLOSIVES

1. Magazines

a. CONSTRUCTION AND LOCATION. Explosives, detonators, and fuzes shall be stowed in bullet-proof, fire-resistant, and weather-proof magazines constructed in accordance with standard designs established by the Bureau of Yards and Docks. The allowable locations of these magazines with relation to other magazines and buildings shall be in accordance with the current quantity-distance tables supplied by the Bureau of Ordnance.

b. SURROUNDING AREA. The ground around the magazine shall be kept free of brush and dry leaves. A fence, preferably of barbed wire, should be maintained around the magazine area.

c. USE FOR OTHER PURPOSE. Magazines in which explosives are stowed shall not be used for any other purpose. Miscellaneous material shall not be stowed in these magazines.

2. Shoes with Nails. Shoes with nails or metal plates that would cause friction sparks shall not be worn in a magazine or around explosives.

3. Order of Use. Stowed explosives shall be used in the order of their delivery.

4. Angle of Stowage. Boxes of explosives should be stowed so that the cartridges will lie flat and not stand on end.

5. Dynamite

a. USE PROHIBITED WHEN FROZEN. No attempt shall be made to use dynamite that is frozen.

b. **BLASTING CAPS.** Under no circumstances shall blasting caps be taken into magazines containing dynamite, either for stowage or for use in making up primers.

c. **DETONATORS.** Detonators shall never be stowed in the same magazine with other explosives such as powder or dynamite.

d. **OPENING PACKAGES.** Packages of dynamite shall never be opened within the magazine, and wooden wedges and mallet only shall be used for opening or closing packing boxes.

6. **Cartridges Discolored.** Any cartridges showing nitroglycerine, crystal, or stains on the outside shall not be used.

7. **Temperature and Humidity.** Buildings in which fuze is stowed should be dry; the temperature should be kept between 45 degrees F and 100 degrees F. Stowing fuze in a damp place retards its burning speed, and fuze that is stowed underground is never in prime condition.

08203 DRILLING

1. **Size of Hole.** All drill holes shall be of sufficient diameter throughout their length to permit free insertion of a cartridge without the necessity of undue ramming or of removing the original wrapper from the dynamite.

2. **Preparation.** The holes shall be made ready before the dynamite is brought to the work and the operations of priming, charging, tamping, and firing carried on with a minimum of man exposure and as rapidly as is consistent with careful work.

3. **Deepening Hole.** Holes that have previously contained explosives shall not be deepened.

4. **Inspection of Old Holes.** Drilling shall not be started until all remaining butts of old holes are examined for unexploded charges.

5. **Unexploded Charges.** Drilling shall not be resumed after blasts have been fired until a thorough examination has been made to make sure that no charges remain unexploded.

08204 PORTABLE AIR COMPRESSORS

1. **Hose Connections.** The hose connections of portable air compressors must be kept tight. These connections shall be inspected frequently to be sure that they stay tight in service.

2. **Safety Valves and Gages.** The safety valves and gages shall be checked frequently so that there will be no doubt that they are in good operating condition.

3. **Towing Equipment.** Fixed tow bars shall always be used when transporting this equipment. Chains and ropes shall not be employed when moving it from place to place. This equipment shall not be towed at a speed beyond that for which the wheel bearings are designed.

4. **Carriage Wheels.** The wheels of portable air compressor carriages shall be checked regularly to be sure they will operate safely when they are used.

5. **Air Receivers and Compressors.** All the usual safety aspects of motors, air compressors, and air receivers must be considered to assure safe operation of this type of equipment. (See 06301-06303.)

08205 LOADING CHARGES

1. **Tamping.** In loading small diameter bore holes, tamping shall be done with a wooden stick having no metal parts, and pressure shall be exerted only when necessary. Quick sharp blows shall never be used.

2. **Locating Charges.** All holes or charges shall be checked and definitely located before firing.

3. **Springing Charges.** Electric detonators should be used for springing charges. The use of short pieces of fuze may result in the charge exploding before the blaster is a safe distance away from the hole. When holes are sprung, leave ample time between springing shots for the hole to cool, and also between the last springing shot and the loading of the main charge.

4. **Loading Near Drilling Prohibited.** Provision shall be made to segregate drilling from loading operations.

08206 PREPARATION FOR FIRING

1. **Selection of Fuze.** A fuze shall be selected which conforms to the condition existing on the operation. Where wet drilling is being done, a tape-covered fuze shall be used, the grade depending upon conditions of temperature and moisture. Where acid is present in sufficient

quantity to make it necessary to line pumps with acid-resisting materials, a triple-tape fuze should be used, the kind depending upon conditions of temperature and moisture.

2. Crimping Tool. Caps shall be fastened to fuzes by means of a crimping tool made especially for that purpose. The use of the teeth or a knife or pliers is prohibited.

3. Vertical Shafts. No blast shall be fired with fuze in vertical or steep shafts.

4. Number of Charges. When 10 or more explosive charges are to be loaded and shot at one time, they shall be fired electrically; fewer than 10 explosive charges to be loaded and shot may be fired by cap and fuze.

5. Blasting Mattress. Before a blast is fired, the rock or other substance to be shattered shall be covered with a blasting mattress or other means, if necessary, to protect workmen, the public, or property from injury or damage from flying rocks.

6. Warning. When a shot is about to be fired, all persons near the place shall receive ample warning and the fuze shall not be lighted or the blast detonated until it is absolutely certain that every person has retreated to a safe distance (not less than 500 feet). The blaster in charge is responsible for posting signalmen and guards to keep vehicles and persons out of the vicinity just prior to the blast.

7. Shelter. Definite places of shelter, if available, shall be assigned to various crews of workmen, and foremen shall be responsible for seeing that men go to designated shelter.

08207 BLASTING MACHINES

1. Care of Blasting Machine. Care must be taken to make sure that the blasting machine is in good working order and of sufficient capacity to fire all shots in the series. The machine should be kept dry; it should not be left outside or underground in a shaft or tunnel overnight.

2. Testing. A blasting machine shall be tested daily when in use and kept in good mechanical condition.

3. Preliminary Trial. The blasting machine should always be tested with a rheostat before operation. It should be operated a few times before making connections; that procedure will make it possible to generate more current.

4. Connecting Leads. No leads shall be connected to a blasting machine until just before the shot is to be fired and all exposed persons have taken shelter.

5. Final Connection. In electric blasting, the blaster in charge shall personally make the final connection and the charge shall be fired by him personally or on his order.

08208 ELECTRICAL WIRING

1. Voltage. When blasting is done by electricity from power circuits the voltage shall not exceed 250 volts.

2. Exclusive Use. Wiring circuits for blasting shall not be used for other current-carrying purposes.

3. Crossing Overhead Wires. Blasting circuit wires shall not cross under overhead electrically charged wires.

4. Safety Switches. Blasting operation controls shall consist of two safety switches (a safety switch and a firing switch) located at least 6 feet apart. Connection between the switches is to be made by a "plug in" jumper which cannot be plugged into the firing switch without unlocking it and which must be removed to lock the switch.

5. Locking Switches. Switches shall both be of a locking, double-pole, double-throw type, and they are to be opened and locked in the downward position which short circuits the leading wires when in the open position. The jumper may be permanently attached to the safety switch.

6. Testing of Circuits. Blasters shall test wiring circuits through charged holes only with approved types of galvanometers, that is, those complying with the current edition of Federal Specifications No. W-B-411. No tests of circuits in charge holes shall be made until men are removed to a safe distance. Lead wires shall be of sufficient length to permit testing from a safe distance. If electric detonators are used, the leads of these devices shall be short circuited by twisting the naked ends together and shall remain so twisted until ready to be connected to the firing line.

7. Electrical Firing. The blaster will avoid trouble in electrical firing by following these rules:

1. tight connections must be made;
2. there must be no short circuits or breaks in the wires;
3. a series connection should always be made when firing with a blasting machine;
4. detonators or relays from different manufacturers should not be used in the same series;
5. care should be taken not to damage the insulation of wires when tamping charges;
6. plenty of time should be taken to check the wiring before firing. Before attempting to fire, the circuit should be tested with a blasting galvanometer to see that the resistance is correct.

08209 INSPECTION AFTER BLASTING

1. **Disconnecting Lead Wires.** After a blast has been fired electrically the lead wires shall be immediately disconnected from the blasting machine or the switch box and carried back at least half the distance to the area of the blast. All wires shall be carefully traced and a search made for unexploded charges.

2. **Waiting Period.** At least 15 minutes shall elapse before investigation of the blasting site shall begin. After this waiting period and after smoke and fumes have cleared to permit good visibility, a thorough inspection shall be made by or under the direction of the blaster to determine whether all charges have been exploded. No other persons shall be allowed to enter the danger zone until the inspection has been completed.

3. **Misfire with Cap and Fuze.** If cap and fuze are used, the blaster shall not return to a misfire until at least 10 hours have elapsed or such longer time as required by state law.

4. **Entering Danger Zone.** If unexploded charges are discovered, no persons other than

those required to handle such misfires shall be allowed to enter the danger zone until the charges have been fired or otherwise destroyed.

08210 MISFIRES

1. **Blaster Responsible.** All operations connected with the handling of misfired charges shall be performed only under the direct supervision of the blaster.

2. **Mishandling Blasting Machine.** In electrical firing it is important that the blasting machine be operated with force and speed, since the faster the rack bar is pushed down, the more current flows through the circuit at the end of the stroke. Observance of this precaution will prevent many misfires.

3. **Faulty Connection.** When a misfire is located after a blast, a galvanometer shall be used to test the circuit for broken wires or faulty connections. If a short circuit or faulty connection is determined to be the cause of the misfire, proper repairs shall be made, the lead wires reconnected, and the charge fired.

4. **Inserting New Primer.** When an unexploded charge cannot be fired through existing connections, the stemming material shall be removed, a new primer inserted and the charge fired.

5. **Removing Stemming Material.** Where it is necessary to insert a new primer in an unexploded charge confined by a solid stemming material, the stemming material shall be removed only by means of a stiff rubber hose with water under pressure. (For complete information, see "The Blaster's Handbook," published by E. I. duPont de Nemours and Co., Inc.)

6. **Extracting Explosives Prohibited.** No person shall be permitted to extract explosives from an unfired hole.

7. **Guarding Unfired Charge.** Under no conditions shall unfired charges be left unattended overnight or until the next shift.

Section 3

CLEARING AND GRADING

General, 08301

Felling and Trimming Trees, 08302

Burning, 08303

Poisonous Plants, 08304

Bulldozers and Tractors, 08305

Graders, 08306

Scrapers, 08307

08301 GENERAL

1. **Protective Equipment.** Personal protective equipment or apparel of approved type shall be worn by workers for protection against eye, head, leg, or foot injuries, and while working in water or swampy areas and on ice and other hazardous surfaces.

2. **Carrying Cases for Tools.** Sharp edge tools shall be transported in carrying cases or sheaths.

3. **Machetes.** Machetes shall be kept in sheaths at all times except when in actual use.

4. **Standing Clear.** All hands shall stand as far away as possible from moving machines, equipment, or moving logs and taut lines.

5. **Lighting.** When operations are conducted at night, adequate artificial illumination shall be provided either in the form of headlights or by general lighting of the work area.

08302 FELLING AND TRIMMING TREES

1. **Clearing Underbrush.** All underbrush, vines, small trees, etc., that will interfere with felling operation, shall be cleared before trimming or felling begins.

2. **Dead Limbs and Rotten Hearts.** Before felling, all trees shall be inspected for rotten hearts, dead or entangled limbs, or similar hazardous conditions. Dead or entangling limbs which endanger employees shall be removed.

3. **Skilled Foreman.** Trees which present an unusual hazard, such as those with rotten heart, dead, hollow, leaning, lodged or multiple growths, shall be felled under the supervision of a skilled foreman.

4. **Undercutting Trees and Use of Wedges.** All trees shall be properly undercut before felling,

with a deep "V" grooved notch on the side where the tree is to fall. Wedges shall be used to throw all balanced trees.

5. **Warning of Falling Tree.** Persons in the danger areas shall be warned prior to the felling of trees. A loud warning call, "TIMBER", shall be given at the time of the felling of each tree.

6. **Avenues of Escape.** Persons engaged in felling trees should look over the area carefully before starting to fell a tree, and note mentally the existing avenues of escape.

7. **Carrying Unguarded Tools.** Workmen shall never climb trees while carrying unguarded sharp-edged tools.

8. **High Winds.** Working in or on trees during high winds is prohibited, except in an emergency, and then only under the foreman's direct supervision.

9. **Securing Felled Tree.** After felling a tree, the tree must be lying on the ground and adequately chocked or otherwise secured before leaving it or going to the next tree.

10. **Trimming Branches.** Before felled trees are trimmed, they shall be properly secured by chocking or other means to prevent them from rolling.

11. **Use of Chain Saws.** Extreme care shall be exercised when using chain saws to fell trees. Chain saws shall not be used to fell rotten heart or hollow trees.

08303 BURNING

1. **Conducted in Clear.** Burning operations shall be kept under strict control and not left unattended. *They shall always be conducted in the clear*, where the fire will not ignite leaves,

dry wooded areas, or nearby buildings. Workmen shall not stand in the smoke. All burning or smoldering material must be *completely extinguished* before workmen leave the scene.

2. **Windward Side.** Firing, punching, and placing of material for burning shall be done from the windward side. This is especially important when poison oak, poison sumac, or poison ivy is being burned.

3. **Flammable Liquids.** Workmen shall never use flammable liquids on piles of material which are burning or smoldering.

08304 POISONOUS PLANTS

1. **Scrubbing Skin.** If a workman has been in contact with poison ivy, poison oak, or sumac, his skin should be swabbed with alcohol and scrubbed with laundry soap and water. A brush or a rough cloth should not be used as they might irritate the skin and increase the danger of poisoning.

2. **Protective Clothing.** Heavy gloves and clothing should always be worn when handling poisonous plants. The clothing of these workers should be cleaned daily.

3. **Burning Poisonous Vines.** When burning poisonous vines it is important to keep away from the smoke, which will carry the poison and may be inhaled.

4. **Medical Care.** If infection develops after contact with poisonous plants, a physician should be consulted. Self-medication with poisonous plant immunization or desensitization extracts should never be undertaken. Men who are extremely sensitive to these poisons should be transferred to other jobs.

08305 BULLDOZERS AND TRACTORS

1. **Speed of Operation.** Equipment of this type shall be operated at a speed such that the machine can be kept under control at all times.

2. **Guards.** Bulldozers used in clearing operations shall be equipped with crank-case guards and radiator protection.

3. **Falling Objects.** Care must be exercised

when using a bulldozer for demolition work, to prevent falling objects from hitting the operators or personnel assisting in the operation.

4. **Felling Trees.** When felling trees with a bulldozer care must be used to avoid falling branches, kickbacks, etc.

5. **Riding Drawbar.** Workmen shall never ride on the drawbar of a tractor. Many serious accidents have resulted from this dangerous practice.

6. Location of Operations

a. **UNDERGROUND UTILITIES.** Operators of bulldozers should find out whether there are or may be underground high voltage cables or gas lines in the area.

b. **OPERATING CLOSE TO CUT.** Bulldozers shall not be operated too close to the edge of a cut, since the bank may give way causing the machine to fall into the hole and be overturned.

c. **INCLINES.** Operators shall drive up sharp inclines slowly and carefully; "gunning" a bulldozer or tractor up a steep or broken slope may cause overturning.

d. **TURNING ON SLOPE.** Operators shall not attempt to turn around on a steep slope. They should back up (or down). Sliding sideways is not in itself dangerous; it is the sudden stop when the tractor hits a solid rock or stump which creates the real danger of the machine rolling over.

7. Towing

a. **CHECKING HITCH.** The operator shall himself check the hitch before starting a tow; a runaway tow is a serious hazard.

b. **NO SUBSTITUTE FOR TOWBAR.** Chains, wire lines, and makeshifts shall not be used for towing; a towbar shall always be used.

c. **COUPLING TRAILING EQUIPMENT.** Coupling up trailing equipment to the tractor is hazardous. The operator must be especially alert while this is being done. Whenever possible it should be done with tractor stopped and gear shift in neutral.

d. **LOW GEAR ON DOWN GRADE.** When towing a heavy load down grade, the tractor shall be kept

in a low gear. Coasting is dangerous; it may cause the tractor to "jackknife".

e. **DETACHING TRACTOR.** After pulling the pin detaching the tractor from a piece of rolling equipment, the groundman shall move into the clear where he can signal the tractor operator. His position then should be such that he can see both pieces of equipment, all obstructions in the line of travel, and the other workmen.

08306 GRADERS

1. **Load Limits of Bridge or Ramp.** Operators shall never operate heavy equipment of this type over a bridge or ramp until load limits have been checked and the bridge ramp approved for that purpose.

2. **Marking with Red Flag.** When a blade grader is being operated slowly on a highway or roadway in hilly or rolling country, a red cloth flag shall be displayed on a staff which projects at least 6 feet above the left rear wheel. In such cases the grader shall be kept to the right of the highway.

3. **Riding on Grader.** Operators shall always ride on the seat or stand on the platform of the grader. They shall never ride on the tandem or on the back of the grader. They shall never permit other persons to ride on the grader in any place but inside the cab or on the platform.

4. **Engaging Clutch.** Operators shall be sure that the gear shift is in neutral before they start the engine. The clutch should always be engaged gently, especially when going up a hill or pulling out of a ditch.

5. **Turning and Braking.** Operators shall always reduce speed before making a turn or applying the brakes.

6. **Down Grades.** The grader shall always be kept in gear when going down steep grades.

7. **Holes on a Hillside.** Extra care should be taken when working on hillsides, to drive slowly and watch out for holes or ditches into which a wheel may drop and cause the grader to overturn.

8. **Pulling Loads.** Graders shall not be used to pull stumps or anything but a *very light* load.

9. **Warning of Obstructions.** There shall be

close cooperation between the driver of the towing equipment and the grader operator so as to avoid shocks or jars to the scraper. Drivers should warn the rear operator of holes, rock outcrops, or stumps in time to prevent damage to the machine or possible injury to the operator.

08307 SCRAPERS

1. **Speed of Operation.** Scrapers shall be operated at speeds consistent with conditions on the particular job.

2. **Scraping Shoulder of Road.** Scrapers should be driven off the shoulders of roads only at slow speeds. On some machines the sudden dropping of one wheel results in violent tilting, with the possibility of serious injury to the driver caused by his being thrown off the machine or against wheels or levers.

3. **Line Attached to Pulling Unit.** A scraper shall never be operated without a safety line attached to the pulling unit. Failure at the drawbar can result in a serious accident.

4. **Replacing Blades.** The scraper bowl should always be blocked up when the blades are being replaced.

5. **Platforms Clear of Debris.** The operating platforms of scrapers and graders shall be kept free of material and debris, also from grease, oil, or mud.

6. **Braking.** When going down hill the operator should not kick the machine out of gear, because increased speed may make control of the equipment extremely difficult. He should leave the machine in gear and use his brakes to control the speed. If the brakes will not hold the load, the operator should drop or drag the scraper bowl to make an emergency stop.

7. **Directing Traffic.** Operators of scraper machines shall not attempt to direct traffic while operating the equipment. A competent signalman should be assigned to direct traffic.

8. **Marking Drag Line.** Vehicles drawing a drag shall be marked to indicate the presence of the drag, or a flagman shall be stationed so as to warn other drivers of the danger.

Section 4 EXCAVATION

General, 08401
Protection of the Public, 08402
Power Shovels, 08403
Loaders, 08404
Bracing of Excavation, 08405
Jacks, 08406
Ramps and Runways, 08407

Trenches, 08408
Ditching Machines, 08409
Pneumatic Paving Breakers and Rock Drills, 08410
Pile Driving, 08411
Well Drilling, 08412
Dredging, 08413

08401 GENERAL

1. **Regulations.** Where they are applicable, federal, state, or local codes, rules, regulations and ordinances governing any and all phases of excavation work shall be observed at all times.

2. **Underground Utility Installations.** Every effort should be made prior to making an excavation to determine whether utility installations (sanitary and storm sewers, water, gas, electric lines, gasoline tanks, etc.) are to be encountered. When the excavation approaches the estimated level of such an installation, the installation should be located from blue prints, if available, or by careful probing and digging, and when uncovered, it should be properly supported and protected.

3. **Removal of Obstacles.** Trees, boulders, and other surface encumbrances located so as to create a hazard at any time during operations shall be removed before excavation is started.

4. **Shoring Adjoining Walls.** If the stability of adjoining buildings or walls is endangered by excavations, necessary shoring, bracing, or underpinning shall be provided to insure their safety. Such shoring, bracing, or underpinning shall be frequently inspected by a competent person and the protection effectively maintained.

5. **Bracing Nearby Excavation.** If it is necessary to place or operate power shovels, derricks, trucks, material, or other heavy objects on a level above and near an excavation, the side of the excavation shall be sheet-piled, shored, and braced as necessary to resist the extra pressure due to such superimposed loads.

6. **Protecting Masonry Wall.** Wherever any side of an excavation is a masonry wall, such

wall shall be braced to insure stability. This shall not include reinforced concrete walls known to be of ample strength.

7. **Sheet Piling.** Temporary sheet piling which has been installed to permit the construction of a retaining wall shall not be removed until such wall has acquired its full strength.

8. **Digging Below Foundations or Retaining Walls.** Except in hard rock, excavations below the level of the base or footing of any foundation or retaining wall shall not be permitted unless the wall is underpinned and all other precautions taken to insure the stability of the adjacent walls for the protection of the workmen.

9. **Undercutting Earth Banks.** Undercutting of earth banks shall not be permitted unless they are adequately shored.

10. **Inspection After Rainstorm.** Excavations shall be inspected after every rainstorm or other hazard-increasing occurrence, and the protection against slides and cave-ins increased if necessary.

11. **Landing Platforms.** All fixed-in-place ladders and stairways giving access to levels 20 or more feet apart shall be provided with landing platforms at vertical intervals of not more than 20 feet. Every landing platform shall be equipped with standard railings and toeboards.

08402 PROTECTION OF THE PUBLIC

1. Walkways and Thoroughfares

a. **GUARDRAILS.** All public walkways, side-walks, and thoroughfares bordering on or running through any construction site shall be provided with substantial guardrails or board fences. In addition, temporary footwalks be-

yond the curb shall be substantially constructed and provided with protection on both sides.

b. CLEAR OF OBSTRUCTIONS. Sidewalks and walkways shall be kept clear of excavated material or other obstructions and no sidewalks shall be undermined unless shored to carry a live load of 125 pounds per square foot.

c. FASTENING PLANKS. If planks are used for a sidewalk they shall be butt ended and cleated underneath to prevent displacement. Planks shall be uniform in thickness and all exposed ends shall be beveled to prevent tripping.

d. RAISED WALKWAYS AND RAMPS. Raised walkways shall be provided with plank steps on strong stringers. Ramps used in lieu of steps shall be provided with cleats to ensure safe walking.

2. Warning Signs and Watchmen. A flagman or watchman shall be designated to warn the public of the approach of trucks and to direct the trucks in and out of the property. Danger or warning signs shall be posted at all truck entrances and exits.

3. Illumination. During the hours of darkness, all public sidewalks and walkways shall be adequately illuminated, and warning lights or flares shall be placed about the property to ensure safety for pedestrians and vehicular traffic.

4. Overhead Protection. The public shall not be required or permitted to travel under loads handled by power shovels, derricks, or hoists, unless ample side barricades and overhead protection are provided.

08403 POWER SHOVELS

1. Inspection and Testing. Power shovels shall be inspected and all motions, brakes, and clutches tested, before starting work.

2. Soft Ground. Extreme care should be exercised when setting the power shovel. Mats or heavy planks should be used on soft ground.

3. Operator Restrictions. No unauthorized person shall be allowed on the operating platform when the shovel is in operation, and the operator shall not converse with anyone while operating the machine.

4. Access to Platform. A suitable ladder, or steps and handholds, shall be provided on power shovels to afford safe and easy access to the operating platforms; these devices shall be maintained in good condition.

5. Removing Shovel for Repairs. In case of a breakdown, the shovel should if practical be moved well away from the foot of the slope before repairs are undertaken.

6. Range of Swing. All persons *must* keep away from the range of the shovel's swing, to avoid being struck by the cab as it rotates. When workmen are required to do some particular work at the rear of the cab of a shovel, they should notify the operator that they are working there.

7. Replacing Wire Cables. The wire rope cables on power shovels shall be regularly inspected and shall be changed when 10 percent of the wires in any 3 feet of length are broken.

8. Leaving Cab. Shovel operators shall not leave the cab while the master clutch is engaged.

9. Leaving Bucket on Ground. All shovels when not in use shall be left with the bucket on the ground.

10. Clearing Overhead Wires. Whenever it is necessary to move the shovel under electric wires a clearance of at least 10 feet shall be provided, together with such precautions as may be necessary to prevent contact between any part of the shovel and wires.

11. Grounding. Power shovels should be effectively grounded and otherwise protected against the hazards of static electricity.

12. Ramps. Ramps to be used by power shovels should not be made too steep. The brakes and travel mechanism should be checked before traversing ramps.

13. Slides. When excavating in a bank of sand, gravel, or rocks which has been dynamited, shovel operators must be very careful not to cause a slide by digging the shovel too far into the bank or making cuts too deep.

14. Shovel as Refuge. When blasting, the shovel shall not be used as a safety refuge.

15. Leaving Cab While Loading. Drivers shall not remain in the seat or cab of a dump truck which is being loaded by a power shovel, a clam shovel, drag line, or other overhead means, even if the truck top is equipped with a steel protective shield. They shall always leave the seat or cab, set the brakes, and remain outside the reach of the swing of the bucket until the truck has been loaded.

16. Equipped as Cranes. Precautions for power shovels equipped as cranes will be found in chapter 9, section 2.

08404 LOADERS

1. Clear of Chains and Sprockets. Operators shall stay away from chains and sprockets of the driving mechanisms of all types of loaders, particularly from the loading end.

2. Guarding Belts and Shafts. Where practical, the belts and transmission shafts of loaders shall be guarded.

3. Electric Motor. Where an electric motor is used as the motivating force the motor should be completely enclosed, properly grounded, and electric conduit of approved type used to connect the motor to the power supply.

4. Combustion Engines. Where a combustion engine is used as the motivating source, transmission lines, gears, shafts, and other moving parts should be completely guarded.

5. Workmen Clear. Workmen engaged in the area where loaders are operating shall take great care to stay well away from loaders while they are operating. All the precautions which should be observed by the operators of trucks, graders, pavers, and other power-driven equipment, and by employees who work around such machinery, are directly applicable to loaders.

08405 BRACING OF EXCAVATION

1. Amount of Bracing. All shoring, bracing, or sheet piling shall be consistent with the magnitude of the work and the character of the soil or material in which the excavation is made.

2. Protection Against Caving. If men are working near the face of an excavation, where the ground is cracked or of such character that caving is likely to occur, sheet piling with shoring and bracing necessary to prevent caving shall be provided.

3. Quality of Timber. All timber used for shoring, bracing, and sheet piling should be sound straight-grained timber equal to long leaf yellow pine, Douglas fir, or other materials of equal strength. All timber shall be free from splits, shakes, large or loose knots, and shall be of the required dimensions throughout.

4. Wooden Sheet Piling. Wooden sheet piling

shall be not less than 2 inches in thickness. The thickness shall be increased as may be necessary to adequately support the sides of the excavation.

5. Temporary Bracing. Where temporary sheet piling is used during excavation work, the shoring and bracing to be provided shall comply with the requirements which follow.

a. INTERVALS. When shores and braces are required they shall be placed at intervals of not more than 8 feet measured parallel with the sheet piling.

b. SOIL PRESSURE. Shores or braces shall bear at the earth against a footing of sufficient area to keep within the allowable soil pressure, "dead men" being buried when necessary to resist the thrust of the braces.

c. WEDGES. Shores or braces at the sheet piling shall not be cut to a bevel but shall be held by wedges and the wedges shall be nailed.

08406 JACKS

1. Size. Workmen should always select the proper size of jack for the load to be lifted. A jack of too light capacity can strip itself, releasing the load; and a jack with too little height will run itself out before accomplishing the purpose intended.

2. Inspection. The jack should be inspected before using. If there is any doubt about the jack's condition, it should not be used.

3. Footing. The jack should be placed on a firm footing where it cannot slip or kick away.

4. Blocking or Cribbing. When the object has been lifted to the desired height, blocking or cribbing shall be immediately placed under it.

08407 RAMPS AND RUNWAYS

1. Dimensions. Ramps or runways used for vehicles shall have a width of not less than 12 feet. Timber guards not less than 8 inches by 8 inches shall be securely fastened on top of the runway along each of the outside edges.

2. Railings. Ramps or runways, when used as passageways for workmen, shall be provided with standard railings.

3. Ruts and Holes. All ramps and runways shall be maintained in a safe and serviceable condition. When ramps and runways are

formed on hard ground without the use of planking, ruts and holes greater than 2 inches deep shall not be permitted.

4. Blocking Stalled Trucks. When the pitch of the ramp requires it, a man shall be alongside a loaded truck with a chock provided with a strong handle for blocking a rear wheel if the truck is stalled or otherwise forced to stop on the ramp.

5. Keeping off Ramps. Workmen, other than chockers, shall be instructed to stay off ramps and runways when trucks are passing over them.

6. Foot Cleats. Where the incline of the ramp is too steep for safe walking, foot cleats, not more than 16 inches apart, shall be provided to prevent slipping.

08408 TRENCHES

1. Shoring. Particular attention should be given to shoring of trenches, especially if there are street cars or railroad lines in the vicinity of the excavation or if men are to work in the trench. In the following paragraphs, provisions for shoring and bracing of excavations shall apply, except when the full depth of the excavation is in stable solid rock, hard slag, or hard shale.

2. Depth and Drainage. The sides of excavations 4 feet or more in depth, or in which the soil is so unstable that it is not considered safe at greater depths, should be supported by substantial and adequate sheeting, sheet piling, bracing, shoring, etc., or the sides sloped to the angle of repose. Surface areas adjacent to the sides should be well drained. Trenches in partly saturated, filled, or unstable soils, shall be suitably braced.

3. Storing Material Nearby. Excavated or other material shall not be stored nearer than 2 feet from the edge of a trench. In the case of extremely deep trenches, material should be stored farther away than 2 feet. The safe storage distance is in proportion to the depth of the trench; the deeper the trench the farther away the material should be stored.

4. Hazards to Traffic. Where pedestrian and vehicular traffic is to be maintained over, or adjacent to excavations, proper safeguards should be provided, such as walkways, bridges,

guardrails, barricades, warning flags, lights, or illumination.

5. Close to a Cut. Where an excavation is close to a cut, particularly when nearer to the cut than its depth, special shoring should be used. Men working in deep trenches shall wear hard hats as a protection against falling material.

6. Ramps, Ladders, and Hoists. Entrance and egress to and from excavations over 5 feet deep should be by ramps, ladders, stairways, or hoists. Workmen should not jump into the trench. They shall not use the bracing as a stairway.

7. Debris. No tools, materials, or debris should be left on walkways, ramps, struts, or near the edge of an excavation. Such material might be knocked off or cause a worker to lose his footing.

8. Distance Between Workers. Pick-and-shovel men working in trenches shall keep a sufficient distance apart so they cannot injure each other when working with their shovels.

9. Gas or Oil Hazards. Extra care should be used in excavating around gas mains, oil tanks, gasoline or oil pipe lines, etc. Smoking or open fires of any kind are prohibited in areas where gaseous conditions are suspected. In such places the air should be tested and, if gas is present, ventilation should be provided by portable blowers or other satisfactory methods.

10. Barricades and Lights. Workmen shall put up barricades and lights around the excavation at the end of each work shift for the safety of personnel moving in that area after dark.

08409 DITCHING MACHINES

1. Clear of Debris. The runways, steps, and handholds of ditching machines shall be kept clear of waste oil, grease and loose tools in order to minimize the possibility of slipping or falling.

2. Care When Starting. Extreme caution shall be used at all times around the machine while the engine is running. Before starting the machinery, care shall be taken to see that all persons are at a safe distance from the moving parts.

3. Attending Machine When in Operation. Operators of ditching machines shall never leave the operator's position while the machine

is in operation, or attempt to remove objects from the conveyor while it is in operation.

4. Clearing Buckets. When clearing the buckets of large rocks, sticks, and roots, workmen out in front of these machines should be afforded a handhold of some kind on the machine. These workers are in danger of falling against moving parts or dropping on to the bucket wheel or chain should the banks cave in. A railing should be placed around the bucket chain on those ditchers which are suited to such action.

5. Standing On or Near Ditchers. Workmen shall never stand on the ditching machine, or between the machine and high banks of soft material where there is danger of a cave-in. When working around a ditcher, they should always be sure that the gear driving that unit is in neutral position.

6. Parallel to High Bank. When excavating in a direction parallel to high banks, ditching machine operators shall exercise caution to prevent loose material and objects from becoming dislodged and falling down on workmen below.

7. Leaving Buckets In Ground. Ditcher buckets shall not be left in the ground when not operating. The sides of the ditch can cave in and injure personnel.

8. Lighting and Flagging. Trenching machines and their operations shall be well flagged by day and adequately equipped with lights when used at night.

9. Pushing Displaced Dirt. Long handled shovels shall be utilized by workmen engaged in pushing displaced dirt out of the path of the trenching machine buckets.

08410 PNEUMATIC PAVING BREAKERS AND ROCK DRILLS

1. Goggles. Suitable goggles shall be worn when operating these machines to protect the eyes from flying particles. These goggles should have strength tested lenses, and should conform to the requirements for Group A goggles as given in U. S. Navy Manual of Safety Equipment NAVEXOS P-422.

2. Paving Breaker. Operators must make sure that the breaker and its accessories are in good working condition.

3. Valves and Trigger. When air is used for

power, the valves and connections shall be checked carefully. Also, when laying down these pneumatic tools, the operator must be careful to see that the trigger cannot be operated accidentally.

4. Untempered Tools. When shock tools are re-dressed the heads shall not be tempered, since hard heads will spall and are more dangerous than those which mushroom.

5. Kinking Hose. Pneumatic paving breaker operators shall never cut off the air supply to the machine by purposely kinking the hose while disconnecting this equipment. Air shall be cut off at the source.

6. Barriers. If the job is near a sidewalk or other thoroughfare, canvas barriers or other suitable screens shall be placed on either side to protect passers-by from flying particles.

7. Roughing Concrete Surfaces. When using a paving breaker to break up extremely hard materials such as heavy blocks imbedded in concrete slabs or with hard and slick surfaces that may cause the tool to slip around instead of biting into the surface, workmen should first use a sledge hammer to roughen the surface. This practice will guard against breaking or cutting the legs or feet.

08411 PILE DRIVING

1. Crew. Each member of a pile-driving crew shall be carefully chosen and shall be experienced or instructed in detail in the work he is to do.

2. Signals. Engineers and winchmen shall not accept signals from anyone but a supervisor or other person especially appointed to give signals. The code of signals used shall be posted in an easily visible place.

3. Steam Condensation. Engineers shall not blow condensation from a steam-driven apparatus while employees are in a nearby exposed position.

4. Protective Apparel. All men handling piles shall wear heavy gloves, safety shoes, and protective hats. Shin and foot guards shall always be worn when heading or pointing piles with axes.

5. Protection from Creosote Spray. When working with creosoted material workmen shall put

on goggles and apply a protective cream or lotion to all exposed parts of the body to protect their eyes and skin from creosote spray.

6. Pile Driving in Water. Where pile driving is done in water from a trestle or from a floating rig, men shall be provided with kapok safety vests or jackets or the equivalent. Each rig shall be equipped with life preservers and life lines for emergency use.

7. Hammer and Driving Heads. When a pile driver is not in use the hammer shall be held in place at the bottom of the leads by a cleat or timber. Driving heads shall be tied in whenever the rig is being used to shift cribbing or other material.

8. Grabline. The grabline shall be in place at all times.

9. Making Repairs. Repairs shall never be made to any steam or air equipment while it is in operation or under pressure.

10. Defective Air Hose. When compressed air equipment is used, defective air hose shall be promptly replaced. Inspections should be made frequently to locate defects.

11. Platform Clear of Debris. The main working platform on the pile driver shall be kept clear of lumber, ropes, and tools.

12. Overhead Wires. Care must be exercised to see that the high parts of the pile driver do not come in contact with overhead electric power lines when the equipment is moved.

13. Drums, Brakes, and Leads. Hoisting drums and brakes shall be kept in the best of condition and sheltered from the weather. Leads shall be kept well greased to provide for perfectly smooth travel of the hammer.

14. Danger from Hammer. A workman shall never place his head or other part of his body under a suspended hammer that is not dogged or blocked in the leads.

15. Cutting and Burning. When steel piling or other metal is being cut by burning, the operator shall wear goggles or a helmet designed to protect the eyes against harmful rays.

08412 WELL DRILLING

Precautions for well drilling and earth boring equipment are similar to those listed above for pile driving.

08413 DREDGING

1. Deck Areas Clear. Good housekeeping shall always be observed on operating dredges. Deck work areas, ladders, catwalks, and passageways shall be kept clear of trash and loose material. Deck fittings and similar hazards should be painted No. 14 Brilliant Yellow.

2. Lights and Fog Horns. Dredges operating in navigable waters must be lighted and meet all other navigational requirements. In foggy weather, horns or bells must be used to warn all watercraft of the proximity of the dredge to traffic.

3. Overhead Power Lines. Workmen on dredges shall never under any circumstances throw ropes or tapes over an electric power line under which the dredge must pass. Such lines may become wet through handling, resulting in a serious electrical burn or fatality.

4. Floating Pipe Lines. Walkways on floating pipe lines shall be provided with suitable handrails and kept in good condition. Floating lines must also be properly lighted to meet navigational requirements.

5. Personnel Protection

a. LIFE PRESERVERS AND LINES. Dredges and floating lines shall always be equipped with life preservers and lifelines for use in emergencies.

b. SAFETY VESTS. Deck hands working on dredges or in small boats shall wear an approved type of safety vest or jacket all the time they are on duty. If the vest becomes wet personnel should change to a dry one as soon as practicable.

6. Special Handling Equipment. When engaged in major repair operations such as dismantling the dredge pump to remove large boulders or tree trunks, removing cutters, or repairing pipe lines or shafting on the dredging ladders, workmen on dredges must use the special handling equipment provided and should exercise extreme caution in handling these heavy parts so as to prevent injury and drowning.

7. Using Small Boats. When approaching the dredge or floating pipe line in a small boat, the approach shall always be made heading into the tide. The boat shall be securely fastened to the dredge or pipe line before any worker leaves it; the oars shall be removed from the locks and placed in the bottom of the boat while not in use.

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United States Navy
SAFETY PRECAUTIONS

Chapter 9
WEIGHT HANDLING AND
CONSTRUCTION EQUIPMENT

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Subsection A

OPERATING RULES

09101 DEFINITION AND SCOPE

1. **Equipment.** "Weight-handling Equipment (Heavy)" as referred to in this section, includes crawler and motor drawn cranes, gantry cranes, portal cranes, tower cranes, hammerhead cranes, overhead traveling cranes, floating and wall cranes, locomotive cranes, derricks, hoists and elevators, and crushing, mixing, batching, and paving equipment. It does not include fork lifts, straddle carriers, and pallet trucks; for safety precautions covering the operation of such equipment, see chapter 2.

2. **References.** Precautions for railroad and automotive equipment are to be found in chapter 4.

09102 PRINCIPAL CAUSES OF ACCIDENTS

1. **Carelessness.** About 80 percent of all injuries from equipment used in construction work and weight handling are caused by unsafe practices of the operating personnel; the accident records show that carelessness is the chief factor in the majority of the accidents. It appears that long acquaintance with equipment breeds indifference and causes the operating personnel to overlook the serious dangers which are always

present when power-driven mobile equipment is in use.

2. **Unsafe Practices.** The predominant unsafe practices and hazardous conditions in the operation of heavy construction equipment are listed below. Operators of all such equipment should study this list carefully, noting particularly the hazards connected with their own work. They should also heed seriously the instructions and warnings of their supervisors regarding safe practices to be followed during operation, making every effort to avoid accidents from any of these 14 major causes:

1. backing and turning machines, swinging booms, lowering buckets, and similar operations without looking, warning, or signaling;
2. getting on and off equipment carelessly while it is in operation, or riding equipment when not authorized to do so;
3. operating equipment with defective brakes, clutches, cables, or other improperly functioning parts;
4. working or walking under skips, buckets, or loads;
5. failing to adjust controls properly before attempting to crank an engine;

6. oiling, adjusting, or repairing equipment while it is in operation;
7. using equipment with unguarded or inadequately guarded engine fans and other dangerous moving parts;
8. failing to use personal protective devices or clothing such as goggles, safety shoes, gloves, and hard hats;
9. failing to properly block equipment or heavy parts while repairing equipment;
10. operating equipment in a thoughtless or unsafe manner, such as moving too fast over rough ground or working too near the edge of a soft fill;
11. operating cranes too close to power lines without adequate watches and supervision;
12. failing to secure equipment, brakes, booms, and movable parts before repairing, leaving, or moving the machine;
13. poor housekeeping either on the equipment itself or in the operating area;
14. overloading equipment.

09103 OPERATING

1. Training of Operators. All operators of construction and weight-handling equipment must be thoroughly trained and properly indoctrinated in the safe and efficient operation of their machines. An apprentice shall always have an experienced operator with him.

2. Physical Fitness. An operator who is not physically able or mentally alert shall not be permitted to start work with any piece of equipment.

3. Inspection. A frequent and regular inspection should be made of all machines. A well-maintained machine is usually a safe machine. All controls such as steering mechanism, brakes, and operating clutches shall be tested by the operator before any work is begun on a new shift. If any of these do not operate properly, they should be adjusted or repaired before any load is moved.

4. Grease. Good housekeeping is a prime necessity for safe and efficient operation. An accumulation of grease on a machine can cause falls and invite fires.

5. Refueling. Refueling of gasoline or diesel-operated equipment shall never be done while

it is in operation. Frequent inspection of fuel lines and tanks for leaks will prevent fires as well as loss of fuel.

6. Gasoline Safety Cans. When transporting gasoline from general supply to equipment in 5-gallon quantities, safety cans shall be used. If tank truck service is not available, gasoline in quantities in excess of 5 gallons shall be transported in steel drums. All bungs shall be tight, and the drum itself checked for soundness. When dispensing gasoline from drums an approved pump should be used.

7. Leaving Machine. An operator shall never leave his machine while the engine is running.

8. Interrupting Work. Upon completion of a work shift, the bucket, dozer blade, etc. shall be rested on the ground, and the brakes and clutches set as recommended by the manufacturer.

9. Guarded Parts. All belts, gears, shafts, clutches, drums, fly-wheels, chains, and other reciprocating or rotating parts of equipment shall be adequately guarded.

10. Removing Guards. Guards, safety appliances, or any other safety devices shall not be removed or made ineffective except for the purpose of making adjustments or repairs, and then only after the power has been shut off. These guards and devices must be replaced immediately after completion of the needed repairs and adjustments.

11. Adjusting Machines. No one shall ever attempt to repair, clean, oil, or grease any part of the equipment while it is in motion.

12. Signals. Adequate warning devices and signals shall be installed on all mobile equipment.

13. Lighting. Adequate illumination must be provided for any night operation.

14. Designated Use of Machine. The use of a machine for any purpose other than on the work for which it was designed is both unsafe and inefficient and is prohibited.

15. Color Code. All Navy construction, fire fighting, railroad, utility, and weight-handling equipment shall be painted in accordance with the instructions contained in the Navy Department Color Safety Code: "The Application of Color to Shore Establishment." District Public Works Officers shall see that all such equipment

under their control is painted to meet the accident-prevention standards of that Code.

09104 AUTHORIZED SIGNALMAN

1. **Identification of Signalman.** One person, only, should be designated as signalman, and both he and the machine operator shall be entirely familiar with the standard hand signals. Where possible, the signalman shall be given some distinguishing article of dress, such as a brightly colored helmet. He must be in a position to closely observe the workmen and still be in plain sight of the operator at all times.

2. **Men in Clear.** The signalman must be sure that all workmen are in the clear before giving the operator any signal.

09105 RIGGERS' RULES

1. **Safety Apparel.** All riggers shall wear protective hats that meet current specifications in use by the Navy. They shall also wear leather gloves and safety shoes.

2. **Safe Methods.** Riggers and others using slings to attach lifts to hoisting equipment should use only the approved safe methods for properly fastening the slings to the load and to the hook. Only experienced men shall do this work. There must be no question about the load being secured against slipping. The load shall always be carefully calculated in advance and no attempt should ever be made to lift a load greater than the rated capacity of the crane.

3. **Hands Away from Chains.** Riggers shall always remove their hands from chains, slings, and load before signaling. They should use a hook or other tool for guiding loads and arranging separators, and always keep hands clear.

4. **Closed Hook.** A safety-type or closed hook should be used with a swinging bucket. This will avoid a bucket coming off the hook should the bucket strike an obstruction.

5. **Point of Hook.** A load shall never be carried on the point of a hook.

6. **Sharp Corners.** A chain sling should be given protection (pieces of rounded wood, heavy bagging, or old rubber tires) on sharp corners, especially in cases where the sling might slide.

7. **Balance and Brakes Tested.** Sharp bends or

kinks in slings should be avoided. When a heavy load is to be lifted, it should first be raised a few inches and allowed to hang long enough to check the balance and test the brake capacity.

8. **Small Loads.** When handling bundles of small material extra care should be taken. More accidents occur in handling small materials than when handling the larger loads.

9. **Angle of Legs of Sling.** Riggers should keep in mind that decreasing the angle between the rope or chain of a sling and the horizontal has the effect of greatly increasing the stress in each leg of the sling. That is, a load can be lifted more safely when all the legs of the sling are in as near a vertical position as possible. On the other hand, the smaller the angle formed between the legs of the sling and the horizontal, the greater the tension of the sling's legs and the less the weight which can be lifted.

10. **Danger of Being Crushed.** Riggers as well as other workmen must be continuously on guard against the possibility of becoming caught between stationary objects and the rear end of cranes or similar equipment.

11. **Maximum Radius and Load.** Extra care shall be taken when handling loads at near maximum radius and when handling near capacity loads.

09106 WORKMEN'S RULES

1. **Stand in Clear.** Workmen on construction jobs should always stand or walk in the clear. They should especially avoid entering or standing in a confined area where a load is being raised or lowered.

2. **Setting Load Down.** Caution shall be used when setting a load down, as it may spread. When withdrawing slings from underneath a lift, workmen should exercise caution to prevent the slings from flying loose and striking someone or catching and tipping the load.

3. **Riding Load Prohibited.** No one shall ever ride on a load or in a sling.

4. **Holding Cable.** Workmen shall never grab hold of a cable as it is being wound on a drum or being pulled through a set of sheaves.

5. **Railway Gondolas.** Workmen shall not stay inside a railway car when a large load is being lifted or lowered in the car, as they have no method of escape should the load swing.

6. Keep Away from Cranes. Workers must always keep well away from cranes and similar equipment, particularly near the rear where the operator cannot see them.

7. Warning Signs. Signs, flags, and other warnings shall be provided to alert workmen against the danger of working around cranes and tracks.

Subsection B

ROPES, SHEAVES, CHAINS, AND HOOKS

09121 FIBER ROPES

1. Inspection. Fiber ropes used to support a human load shall be inspected when installed and thereafter as frequently as may be necessary to insure their safe condition. Visual inspection should be made for abrasion, broken fibers, cuts, fraying, and deterioration due to acids or corrosive substances. Ropes found to have defects shall be removed from such service.

2. Dragging Rope. Rope shall never be dragged along the ground or over rough or dirty surfaces.

3. Storing Rope. Ropes not in use should be stored in a dry, well ventilated place supported on slats or hung in loose coils. They shall never be exposed to lime or acids, nor stored in a room containing acids.

4. Sheaves and Blocks. Sheaves and blocks built for wire rope shall never be used for fiber rope.

5. Sharp Edged Burdens. When objects with sharp edges are to be lifted with ropes, protective pads shall be placed between the edges and the rope.

09122 WIRE ROPE AND SLINGS

1. Good Condition. Hoisting equipment should always include slings or other lifting devices, which shall be kept in good condition.

2. Rust Prevention. Wire rope slings shall be frequently inspected and lubricated in accordance with manufacturer's recommendations to

keep them pliable and prevent rust. Rusty ropes are dangerous because corrosion can then quickly develop inside and outside.

3. Removing Rope from Service. Wire rope used for the purpose of raising or lowering men or material shall be removed from service when:

1. the number of broken wires in any pitch length or lay of rope total the number shown in the following table:

Wire Rope	Number Broken Wires
6 x 7 -----	3
6 x 19 -----	6
6 x 37 -----	9
8 x 19 -----	8

2. the wires in the crown of the strand are worn to less than 60 percent of their original diameter;

3. inspection indicates a dangerous amount of corrosion or distortion.

4. Damaged Equipment. Hooks, shackles, rings, pad eyes, or slings that have been deformed or damaged shall be removed from service.

5. Socket Attachments. Properly attached standard sockets shall be used for making new wire rope connections. The use of wire rope clips for wire fastenings is not recommended.

6. Rope Clips. Where wire rope clips are used to assemble a connection, the U-bolt shall be over the bitter end of the rope and the minimum number and spacing of clips shall be in accordance with the following table:

<i>Diameter of Wire Rope (inches)</i>	<i>Size of Clip</i>	<i>Number of Clips</i>
$\frac{5}{16}$	$\frac{3}{8}$	3
$\frac{3}{8}$	$\frac{3}{8}$	3
$\frac{7}{16}$	$\frac{1}{2}$	4
$\frac{1}{2}$	$\frac{1}{2}$	4
$\frac{5}{8}$	$\frac{5}{8}$	4
$\frac{3}{4}$	$\frac{3}{4}$	4
$\frac{7}{8}$	1	5
1	1	5
$1\frac{1}{4}$	$1\frac{1}{4}$	5
$1\frac{3}{8}$	$1\frac{1}{2}$	6
$1\frac{1}{2}$	$1\frac{1}{2}$	6
$1\frac{3}{4}$	$1\frac{3}{4}$	6

Spacing between clips shall be approximately six rope diameters.

7. Adjustments to Guy Wires. Turnbuckles shall not be adjusted nor shall any other adjustment be made to the holding guys while any workman is aloft on a guyed pole or mast.

8. Protective Pads. Protective pads shall always be used where the sling is exposed to sharp edges at the corners of a load.

9. Twisting. A wire rope should be handled carefully so that it is neither twisted nor untwisted.

09123 SHEAVES AND DRUMS

1. Worn Equipment. Sheaves, drums, or pulleys which have become worn, chipped, or the grooves corrugated shall not be used because they will injure the rope.

2. Use Proper Rope. Sheaves and blocks designed for use with fiber ropes shall not be used for wire rope, since they are not strong enough for that service and the wire rope does not fit the sheave grooves.

3. Gate Block Hooked. A gate block shall always be closed and hooked before being used.

09124 CHAINS

1. Dangers. All hoisting chains shall be inspected at frequent intervals for such defects as

stretch, wear, gouge marks, open welds or fractures as indicated by very fine surface cracks, and shall be removed from hoisting service when such defects are found. Chains are less reliable than manila or wire rope as they break without any warning.

2. Stretched Chains. Chains which have stretched more than 5 percent in any five link section shall be discarded. Chains, which in any individual link show wear greater than 25 percent of the thickness of the metal, shall be removed from service.

3. Storing Chains. Chains shall not be stored where they will be run over by tractors, trucks, or other equipment.

4. Makeshift Repairs Prohibited. Makeshift repairs such as splicing with bolts shall not be used on hoisting chain or chain slings.

5. Kinks. Chains should not be subject to sudden shock while in use. Loads shall not be lifted with a kinked or knotted chain.

6. Fittings. Attachments or fittings for chains should be of the type, grade, and size suitable for service with the size of chain used.

7. Annealing Wrought Iron Chains. Wrought iron chain shall be annealed by qualified workmen at least annually and a record of such treatment maintained.

09125 HOOKS

1. Strength. Hooks and rings used with chain should have at least as great strength as the chain. Hooks should be given a visual inspection at the beginning of each work day and prior to lifting the full rated load.

2. Bent Hook. When a hook has been bent by overloading, it should not be straightened and put back into service. A new hook shall be used in such cases.

3. Locking. Hooks that close and lock should be used where there is danger of catching on an obstruction. This applies particularly to hoisting buckets, cages, or skips, and especially in shaft work.

Section 2

CRANES AND DERRICKS

Subsection A Cranes

- Chief Hazards, 09201
- Crawler, Truck, and Tractor-Mounted Cranes, 09202
- Locomotive Cranes, 09203
- Overhead Cranes, 09204

Subsection B Derricks

- General, 09221
- Breast Derricks, 09222
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- Guy Derricks, 09226

Subsection A

CRANES

09201 CHIEF HAZARDS

The primary hazards of operating mobile type cranes, shovels, and draglines, are:

1. Unsafe Equipment

1. dropping or slipping of load;
2. breaking of cables;
3. non-use of outriggers;
4. faulty or poorly adjusted brakes and clutches;
5. clutch or brake slipping and allowing boom radius to increase;
6. job exceeding safe boom radius;
7. job exceeding capacity of crane;
8. operating with bent or damaged boom.

2. Unsafe Practices

1. overloading or exceeding capacities;
2. obstruction to the free passage of the boom or the load of the crane;
3. backing and turning of machines without looking or signalling;
4. operators not being familiar with equipment;
5. operating on uneven ground;
6. lifting load to an unknown greater radius;
7. boom contacting high tension wires.
8. using weight indicators without checking by common-sense judgment;

9. not changing capacity charts on cranes when different boom lengths are used;
10. use of boom with bent or dented chord members;
11. use of weight indicators as weighing devices.

3. Operating Near High Tension Lines. Crane booms should never be operated near high tension power lines if it can be avoided. If work must be done in their vicinity, effort should first be made to have the power lines de-energized before starting work. If that is not possible, then make sure that at no time the boom or fall cable comes closer than 10 feet to the high tension lines while the crane is operating. Operators should not depend on any chain or other grounding device dragging along the ground to give protection against electrical current discharges through the crane. Such a device is not a safe means for grounding a crane and gives the operator a false sense of security.

The electrocution hazard created when a crane boom or fall cable touches a power line is an extremely serious one. When a boom or cable does touch a high tension wire, creating a short, the operator should either stay in his position on the machine *keeping his hands off the controls*, or *jump clear* of the machine. He

should never dismount from the machine by climbing down the side thereby permitting his body to come in contact with the machine and the ground at the same time. He should also warn all ground crews not to touch units in contact with the wire.

09202 CRAWLER TRUCK, AND TRACTOR-MOUNTED CRANES

1. Care of Equipment

a. **STOWING TOOLS.** Tools and other maintenance items shall be kept in the tool box.

b. **FIRE EXTINGUISHERS.** All mobile cranes shall be equipped with appropriate fire extinguishers which shall be maintained ready for use.

c. **DANGER OF HIGH WINDS.** A high boom with no load in a high wind shall be avoided; this condition might tip the crane backwards.

d. **STRIKING BOOM.** Whenever a load strikes the boom or the boom strikes an object, the boom should be lowered immediately and carefully examined for bent or damaged members. A slight bend in the boom structure can cause it to fail and collapse.

e. **MOVING CAPACITY LOAD.** No one shall travel with a near-capacity load nor travel and rotate simultaneously with a near capacity load. If the travel surface is uneven the machine may upset. When necessary to move a capacity load it should be placed on a truck or railroad car and then unloaded at the new location. Radius indicators and capacity charts shall be provided on all such equipment.

f. **TRAVELING PRECAUTIONS.** When traveling from one weight-handling job to another, the boom shall be set in the boom rest, when available, or parallel to the general direction of travel and at an angle to clear any overhead obstruction. The boom shall not be raised or lowered while traveling. No crewman shall ever ride under the boom.

2. Inspection

a. **SAFE LOAD CAPACITY.** Every crane shall be inspected and tested annually for safe load capacity in accordance with BuDocks Circular Letter 45-46 dated 6 July 1946. The safe load chart shall be posted in a prominent place in the cab near the operator, who shall familiarize

himself with the safe working and tipping capacity of that crane.

b. **BOILERS.** Boilers on steam-operated cranes should be periodically inspected and tested in accordance with the ASME Power Boiler Code.

3. Personnel Restrictions

a. **AUTHORIZED PERSONNEL.** Cranes shall be operated only by authorized personnel who are thoroughly trained in the fundamental rules of crane safety.

b. **BOARDING CRANE.** Operators shall enter and leave the crane by means of the ladder provided for this purpose. No other person shall board a crane until permission has been given by the operator.

c. **CLIMBING ON MOVING CRANE.** No personnel except the operators shall be permitted on the crane while it is in operation. No one shall ever climb on or off a moving crane.

4. **Calculating Load.** The weight of the material to be lifted should always be carefully calculated in advance; no chances should be taken on the result of a quick estimate. Also the radius at which the load will be lifted and set down should be accurately determined and compared with the capacity chart of the machine. On almost all truck and crawler locomotive cranes the weight of the hook, blocks, cable, and slings is part of the lifted load. Allowance must be made for this extra weight.

5. **Lifting Load from Water.** When lifting a load from water, its condition should be noted carefully. Contained water, or water in a waterlogged structure, should be computed as a part of the weight. When the load leaves the water the crane takes on the added load as its buoyance is lost. Unknown weights should never be lifted from the water; that is an extremely hazardous procedure. Waterlogged loads or loads from water or mud should never be handled without the approval of the Officer-in-Charge of Construction or the Public Works Officer responsible for the specific job.

6. **Testing Load.** When a heavy load is to be handled, the crane or hoist operator shall first raise it a few inches to find out whether or not there is undue stress on any part of the sling and to make sure that the load is well balanced. If anything is found to be wrong with the brakes or the engine, or with the adjustment

of the sling, the load shall be lowered at once and no attempt made to move it again until the necessary adjustment or repairs have been made.

7. Testing Brakes. When lifting a capacity load, the brakes should be checked by stopping the lift a few inches above the ground and holding it with the brake.

8. Hoisting Line Vertical. Before lifting a near-capacity load, operators must be sure the hoisting line is vertical. They should move the crane to position rather than lower the boom; a swinging capacity load increases the chance of tipping. They should never try to lift tied-down loads, or pull pipes or other objects out of the ground.

9. Angle of Load. Loads should be lifted only when lifting cable is in vertical position. Lifting a load with the cable at an angle develops twisting stresses in the boom which can cause buckling. Also the swinging of the load after it is lifted clear of the ground may cause the crane to upset.

10. Setting Outriggers. When lifting a critical load, the outriggers shall be set on all sides, since if the load is dropped, the kickback may tip the crane backwards.

11. Speed of Lowering. When lowering loads, the speed should be limited; it should not exceed the hoisting speed of the equipment for the same load. The ordinary hoisting speed of a 30-ton motor-operated crane is about 18 feet per minute with rated load. Stopping the load at such speeds within a short distance may double the stress on the slings and crane.

12. Swinging Loads. Care shall be exercised continuously to guard other workmen, buildings, or scaffolds against injury from swing loads. Loads should not be swung over workmen. If it is absolutely necessary to move loads over space with personnel working below, adequate warning must be given by bell or siren so the workmen can move into safe places.

13. Level Footing Important. When operating a crawler-type crane over soft or uncertain ground, mats should be used to ensure a level footing. In such places truck cranes should be used either with planking or pontoons placed under the truck, or with outriggers.

09203 LOCOMOTIVE CRANES

1. Removing Steps and Grabs. Before placing a locomotive crane in operation at a naval activity all steps and hand grabs, except those necessary for access to the cab, shall be removed. (Note: These steps and hand grabs must be replaced before the crane can be moved over the main line of a railroad.)

2. Boom at Right Angle to Track. When making heavy lifts with the boom at right angles to the track, unless the weight of the load is accurately known the outriggers shall be extended and blocked so as to prevent upsetting.

3. Crane Derailed. If a locomotive crane has been derailed, a wrecking frog or car replacer (or its equivalent) should be used to rerail the crane and it should be hauled back on the track by external power.

4. Curving and Nonlevel Track. Locomotive cranes shall not work on a curve, or on any track out of level, without having outriggers thoroughly set in place. *A variation of 1 inch in the level of standard gage track may reduce the lifting capacity of this type of crane approximately 60 to 80 percent.*

5. Dual Lifts. Dual lifts are extremely dangerous, and should be attempted only when absolutely necessary, and then only under competent supervision throughout the entire operation. Before making a dual lift the proper position of the cranes and the location of the slings to balance the load properly for each crane should be carefully determined. Shifting of the load could cause overloading and failure of one crane, thus throwing the entire load onto the second crane and resulting in the failure of both cranes.

6. Radius. Radius indicators and capacity charts shall be provided on all locomotive cranes.

09204 OVERHEAD CRANES

1. Fire Extinguishers. All overhead cranes should be equipped with appropriate fire extinguishers which shall be maintained ready for use.

2. Leaving Crane Unattended. Load should never be left on overhead cranes overnight, or

for a longer period than is absolutely necessary. If the load hook is left hitched to an object and the crane operator has to leave the crane, the switches shall be pulled and tagged with a notice such as "SWITCH OPEN—DO NOT OPERATE".

3. Turning Off Power. When leaving the crane, all controllers shall be placed in the "OFF" position, the main switch opened, and the brakes set.

4. Care in Closing Switch. If the operator starting on duty, finds a main or emergency switch open, he shall not close it until he has made sure that no one is on or about the crane. If there is a "MAN WORKING" warning sign on the switch, he shall not remove it unless it was placed there by himself, and he shall not close the switch until the warning sign has been removed by the man placing it there.

5. Standing Over Turbo-Generator. Cranes when not in use should not be left standing over a turbo-generator unit.

6. Changing Operators. When changing oper-

ators on an overhead crane, the change shall always take place *on the ground, not in the cab.*

7. Load Over Workman. When any load is on the hook, no one shall pass beneath the hook. Crane operators shall never move a load over a workman.

8. Pushing Cranes. Bumping into runway stops except to correct excessive skew, or into other cranes, shall be avoided. If the operator is ordered to engage with or push other cranes, he shall do so with special care for the safety of persons on or below the cranes, and only after making sure that any persons on the other cranes are aware of what he is doing.

9. Access Ladders. Each overhead crane runway shall be equipped with an access ladder at each end of the craneway. Ladders shall be made of steel and have a protective cage extending within 7 feet of the floor. At the top of each ladder, a platform, at least 2 feet by 2 feet, shall be installed where employees may board the crane. Access to crane shall be made from the stationary platform to a landing platform attached to the crane cab and at the same level.

Subsection B

DERRICKS

09221 GENERAL

1. Load and Radius Indicator. All derricks shall be used in such a manner that no part shall be stressed beyond its safe working strength. They shall have radius indicators and capacity charts.

2. Inspection. Each derrick shall be inspected and all brakes, clutches, frictions, and motions tested daily by competent personnel, and a record of all inspections shall be kept at the scene of operations until completion of the job.

3. Experienced Operators. Derricks shall always be operated by experienced workmen.

4. Foot Blocks. The foot block of every derrick shall be solidly supported and firmly secured against movement in any direction. Shores shall be placed against the foot blocks of the derrick to prevent any horizontal movement.

5. Lines and Booms. Loads, load lines, and booms shall not be permitted to strike against scaffolds, objects, or structures.

6. Riding Loads. Workmen shall not be allowed to ride on loads handled by derricks.

7. Walking Under Load. Loads shall not be lifted or swung over the heads of persons and no one shall be permitted to walk under a load.

8. Securing Boom. When work is stopped or when the derrick is not in operation, the boom shall be lowered to a horizontal position or tied in place to prevent wind from blowing it out of control.

9. Reference. Additional information may be obtained from the American Standards Association publication, *Safety Code for Cranes, Derricks, and Hoists.*

09222 BREAST DERRICKS

1. **Set on Planks.** Breast derricks, used principally for setting stone, shall be set on heavy planks—never directly on newly-laid floor arches.

2. **Bracing.** Where a breast derrick cannot be guyed from the front or load side, a strut or stiff triangular brace shall be fastened to the back of the derrick to prevent it from falling backwards should the pull of the load be changed to other than vertical.

3. **Guarding Gears.** All gears shall be effectively guarded and a ratchet and pawl which will hold the load at any desired height shall be provided.

4. **Handle of Lever.** A hole shall be drilled in each end of the gear shaft outside the operating lever, and a cotter pin placed in each hole to prevent the handle from slipping or working off the shaft.

5. **Lowering Load With Brake.** Crank handles shall be removed from the crankshaft before any load is lowered by means of the brake and they shall be kept removed as long as the brake is being so used.

09223 PIPE-LAYING DERRICKS

1. **Guards.** All gear wheels and blocks shall be effectively guarded.

2. **Securing Cable at Night.** At night the rope or cable shall be wound up until the blocks meet, and the drums shall be chained and locked.

3. **Top Heavy Load.** When motor truck and caterpillar derricks are used, positive means shall be taken to prevent the load from overturning the supporting vehicle.

09224 GIN POLES

1. **Guying.** Gin poles shall be properly guyed according to the type used.

2. **Anchoring.** Guys shall be attached to "dead men" or other approved type anchors, or to some permanent stable object.

3. **Spacing of Anchors.** When the guy lines are anchored to a permanent structure the anchors shall be located at least one-half the height of the pole from its base, and when "dead men" are used, the distance from the base shall be at least one and one-half times the height of the pole.

09225 STIFF-LEG DERRICKS

The weighting and anchoring of a stiff-leg derrick shall be such as to assure stability of the derrick. The material for weighting should be enclosed in well-constructed boxes.

09226 GUY DERRICKS

1. **Cables.** Wherever possible, the top of the mast on guy derricks shall be steadied by not less than six cables spaced so as to make the angles between adjacent cables approximately equal.

2. **Eyes at Masthead.** On guy derricks, eyes shall be formed in the guys at the masthead end by the addition of properly attached socket fittings. The use of U clamps on the short end of a wire rope for making fastenings is not recommended.

3. **Fall Line Vertical.** The fall line shall be vertical before a lift is made.

Section 3

HOISTS AND ELEVATORS

General, 09301

Inside Material-Hoist Shaftways, 09302

Material-Hoist Platforms, 09303

Outside Hoisting Towers, 09304

Hoisting Engines, 09305

Cables and Sheaves, 09306

Concrete Bucket Towers, 09307

09301 GENERAL

1. **Inspection.** All hoisting equipment shall be periodically inspected and tested, at least monthly, and brakes, gears, and operating levers maintained in good working order. Any hoist that becomes defective or any hoist that is not in good working order shall be plainly tagged to this effect and shall not be used until repaired and tested.

2. **Load Capacity.** Before any hoist is placed in operation, the maximum load capacity shall be determined and, under no circumstances, shall the hoist be used for lifting loads above that capacity. Load capacity of hoisting apparatus shall be prominently displayed.

3. **Reliable Operators.** Hoists or elevators for lifting workmen or materials shall be operated only by competent and reliable men.

4. **Hatchway, Hoist, or Tower.** Men shall not work in or on a hatchway or hoist tower when the hoist is being operated.

5. Signals

a. **KINDS PERMITTED.** A standard signal system shall be used on all hoists. Whistle signals on hoisting work are dangerous, and their use is not recommended. Hand signals are more reliable where the engineer can always see the signalman; but a mechanical bell at the engine, operated by pulling a wire, is much more satisfactory.

b. **HOIST SIGNALMAN.** Hoist signals shall be given only by the assigned signalman.

c. **CODE POSTED.** The signal code shall be

posted near the signal device at each work level, and it must be kept clearly visible.

6. **Keep Clear of Shaftway.** While waiting for the hoist, workmen shall never put their heads into the shaftway to see where the hoist is. They can tell whether or not the hoist is moving by watching the hoist cable; they can note its location from the loading platform.

7. **Locking Device for Cage or Platform.** When it is necessary for workmen to enter the cage or platform of any material hoist or elevator other than at the bottom landing, some locking device must be provided to prevent the cage or platform from being lowered or raised while the workman is entering or leaving the cage.

8. **Electrical Signaling Device.** If an electrical signaling device is placed on the cage and this is the only method used to signal the hoisting engineer, the locking device may be omitted.

09302 INSIDE MATERIAL-HOIST SHAFTWAYS

1. **To Be Enclosed.** All material-hoist shaftways erected inside buildings should be enclosed tightly for their entire height. When this is not practicable, the sides of the shaftways not used for entrances shall be enclosed on each floor to a height of at least 8 feet with wire netting formed of not less than No. 16 U. S. gage wire, one and one-half inch mesh, or enclosed with wooden slats spaced vertically not more than 1½ inches apart, with a toe board placed around all sides except at the entrance.

2. Adjacent Shaftways. When two material shaftways are erected side by side, similar protection shall be placed between them, except where enclosed cabs are installed.

3. Bars and Gates. All entrances into the shaftway shall be protected by hinged or pivoted bars or by gates.

4. Guide Rails Rigid. The guide rails of all hoists shall be kept rigid and in perfect alignment at all times.

5. Construction of Guide Rails. The guide rails shall be of sound lumber or steel of adequate uniform size to provide a firm track.

6. Sheave Beams. Overhead sheave beams and their supports shall be of good sound timber or steel of adequate strength and stiffness.

7. Protection of Hoists. Protective covering of planking or heavy wire netting shall be provided above the overhead work of all hoists to prevent objects falling down the shaftway.

09303 MATERIAL-HOIST PLATFORMS

1. Safety Factor. Material-hoist platforms shall be substantially constructed and of sufficient strength with a factor of safety of five for the rated load and capacity.

2. Protection of Crosshead. Overhead protective covering of planking or heavy wire mesh shall be provided on the crosshead of every material-hoist platform to prevent objects falling on the workmen when loading or unloading the hoist.

3. Hinged Sections. The protection on the cross-head shall be made in sections and each section hinged, so they may be raised when hoisting long material.

4. Hoisting Long Material. When using a hoist for long material, the several pieces of the material shall be securely fastened together and made fast to the hoist so that no part of the load can fall or project beyond the sides of the hoist and get caught.

5. Blocking. Suitable blocking and cleats shall be provided on all platforms when wheelbarrows or other rolling equipment are transported, to hold them securely in place.

6. Enclosed Sides. The platform of every hoist shall be enclosed on the sides not used for loading or unloading, with toe boards and a heavy

wire screen enclosure formed of No. 16 U. S. gage wire, one and one-half inch mesh.

09304 OUTSIDE HOISTING TOWERS

1. Construction. All material-hoist towers built of wood erected outside of buildings shall be constructed of strong, sound materials, which shall be No. 1 common Douglas fir or equivalent except for cab or bucket guides, which shall be clear, straight-grained Douglas fir or equivalent, free from knots or other defects. Towers should be plumb and square at corners.

2. Wooden Members. Wooden members for the corner posts may be built up of 2-inch laminated material. The wooden members, such as splice pads, braces, etc., may be bolted or nailed. No bolt less than $\frac{1}{2}$ inch in diameter shall be used.

3. Strength. Towers other than wooden towers may be used if equivalent strength is provided.

4. Cross Bracing. The diagonal cross bracing shall be placed on each of the four sides of tower and between horizontal cross ties except at loading and unloading platforms, in which case some other bracing of equivalent strength shall be provided.

5. Removal of Braces. Not more than two diagonal braces shall be removed from any panel point in the tower and never from two consecutive panels.

6. Foundations. Foundations for hoist towers shall be sufficiently large to spread the hoist load so that it will not exceed the safe bearing capacity of the soil on which it stands. Foundations shall be level.

7. Splicing. All splices in posts shall be not less than 2 inches in thickness, 4 feet long, and shall be spiked or bolted to at least 2 adjacent sides of the posts. All splices shall be staggered.

8. Ladder. A strong ladder, securely fastened to the tower, shall extend its entire height. (See 07111,5, "Fixed Ladders.")

9. Anchoring. Hoist towers shall be securely guyed and well anchored.

10. Securing Guys. The guys shall be securely clamped to "dead men" of sufficient size, and well buried unless adequate building anchorages are available.

11. Platforms. Platforms of ample size and

strength, with railings and toe boards, shall be built at each level where men work.

12. Enclosed Sides. Hoist towers shall be enclosed on all sides for their entire height with a wire screen enclosure formed of No. 16 U. S. gage wire and one and one-half-inch mesh securely fastened to the tower structure. Properly protected openings shall be formed on each floor level.

09305 HOISTING ENGINES

1. Specifications. All gearing on hoisting engines shall be enclosed or suitably guarded. Steam piping shall be insulated and, if electrical equipment is used, it shall be effectively grounded.

2. Electric Motors. Where electric motors are used, unauthorized persons shall not tamper in any way with the electrical apparatus, and all repairs and adjustments shall be made by competent electricians. See chapter 18.

3. Protection from Weather. The hoisting engine and the engineer shall be protected against the weather and from falling objects by a substantial covering.

4. Inspection. All hoisting equipment shall be frequently inspected, and brakes, gears, and operating levers kept in perfect working condition.

5. Guards for Cables. Guards shall be provided where necessary to prevent persons coming in contact with hoisting cables.

6. Grease on Brake Drums. Brake drums shall be kept free of oil or grease or any substance which reduces their efficiency.

7. Securing Load. A pawl or dog shall be used in addition to the brake to hold the load when it is to be suspended for any considerable length of time.

8. In Public Places. Hoisting engines should not be set up in the street, but if they must be so located they shall be completely housed-in

for the protection of the public, the engine, and the operator.

09306 CABLES AND SHEAVES

1. Specifications. Hoisting cable shall be not less than plow steel grade and shall be so constructed of wires and strands of wires as to be equal in flexibility to standard plow steel hoisting rope composed of 6 strands of 19 wires each. No hoisting cable less than $\frac{1}{2}$ inch in diameter shall be used except for small winches as used on gin poles, etc., where $\frac{3}{8}$ -inch cable may be used.

2. Fastenings. Cable fastenings shall be substantially and securely made and maintained. Only properly attached sockets should be used for new wire rope fastenings. (Article 09122.)

3. Worn Sheaves. Sheaves that have become worn, chipped, or the grooves corrugated should not be used, as they will injure the rope. See 09201, 09203.

4. Cast Iron Sheaves. Cast iron sheaves shall be tested with a hammer before using to make sure they are not cracked or broken. Cast steel sheaves are to be preferred.

09307 CONCRETE BUCKET TOWERS

1. Standards. Concrete bucket towers shall conform to the standards set for material hoists and towers, and shall have similar protection and shaftways.

2. Platforms and Runway. Openings with platforms shall be formed at each floor level, and the runway leading to the tower shall be guarded with railing and toe guards.

3. Riding Bucket. Workmen shall never ride in the bucket.

4. Hoist Pit. The hoist pit shall be kept drained. Workmen shall not enter the pit to make repairs without first making sure that the bucket is resting on the blocking on which the bucket rests while being filled.

Section 4

PAVING AND CONCRETING

Subsection A Equipment

Rock Crushers and Batching Plants, 09401
Concrete Mixers, 09402
Asphalt Plants, 09403
Pavers, 09404
Belt Conveyors, 09405

Subsection B Concrete Construction

Form Building and Erection, 09421
Form Stripping, 09422
Spouting, 09423
Runways, 09424
Mixing and Placing Concrete, 09425
Concrete Buggies, 09426

Subsection A

EQUIPMENT

09401 ROCK CRUSHERS AND BATCHING PLANTS

1. **Platforms and Ladders.** Proper working platforms and safe ladders adequately equipped with guardrails shall be provided on each rock crusher and batcher.

2. **Falling Rocks.** Ground crews shall be protected from falling rocks or other material that may be dropped. Protective hats shall be worn by these workmen.

3. **Dust Protection.** Equipment for protection against dust shall be provided for all cement handlers, and this equipment must be worn wherever applicable.

4. **Power Lines.** Care must be taken to make sure that high portions of this equipment do not come in contact with nearby electric power lines.

09402 CONCRETE MIXERS

1. Skip

a. **Loader Cables.** Frequent inspection of the skip loader cables and brakes shall be made to prevent possible injury from a falling skip.

b. **Blocking.** Whenever it is necessary to work

under a skip, the skip must be solidly blocked into position to prevent it from falling should the brake fail or be released.

2. **Surrounding Area.** The area around a mixing plant shall always be kept clean; waste material shall not be allowed to accumulate near it.

3. **Dust Protection.** Dust protection shall be provided for all personnel working with cement or cement sacks.

4. **Hopper.** If an elevating hopper is used, the machine operator shall always see that all the workmen are out of danger before the hopper is lowered. The hopper itself should be guarded by barriers on the side to prevent anyone walking under it while it is being lowered.

5. **Cleaning Drum.** The switches shall be opened, the throttles closed, and the operating mechanism of mixers locked in the "Off" position when men are cleaning inside the drum.

6. **Watchman and Warning Signs.** If possible, a flagman or watchman should always be stationed near a mixer when batching trucks are backing up to it, and he should use a whistle to warn all workmen who are in the danger zone. If such a watchman is not available,

"DANGER—KEEP AWAY" signs should be placed conspicuously on each side of the mixer to warn the workmen.

09403 ASPHALT PLANTS

1. **Fire Prevention.** Hot mix plants shall have adequate safeguards for preventing fires. Asphalt spreaders shall be properly maintained so as to prevent injury to the operators and to prevent fires.

2. **Guards.** Mixing plants shall have suitable guards on all moving parts that might jeopardize the safety of the operators or the maintenance crews. Safety guards against the spilling of hot asphalt on operating personnel should also be employed.

3. **Protective Apparel.** Workmen handling tar or asphalt shall wear gloves, goggles, safety shoes and suitable heavy clothing to prevent burns from bubbling or splashing hot material. Trousers should be fastened tightly around the ankle.

4. **Ventilation.** Adequate ventilation shall be provided to maintain fumes from hot asphalt, tar, oils, etc. at safe concentrations for personnel.

5. **Traffic Control.** Proper traffic control shall be maintained at all times around the mixing and batching plant when workmen or trucks are working in that area.

09404 PAVERS

1. **Skip Guards.** Wherever practical, road building mixers should be equipped with a guard to prevent workmen from walking under the skip when it is raised to the charging position.

This skip guard should be serviced regularly and never allowed to get out of order. It should be taken off the machine for repairs only when the mixer is idle.

2. **Load Warning Bells.** Pavers should be equipped with a load warning bell, which should always be used when the paver is being moved ahead or when the bucket is run out among the puddlers and the men placing steel and joints.

3. **Backing Truck.** The paver skip signalman must be active and alert. He should always warn men working on the subgrade when a truck is backing into a skip, and he should signal the truck driver when all men are in the clear.

4. **Waste Material.** Waste material shall not be allowed to accumulate around pavers.

5. **Cables and Sheaves.** Cables and sheaves of pavers shall be inspected daily.

6. **Warning Signs.** Plenty of "ROAD CLOSED" warning signs, used separately or placed together to form a long barricade, should be employed on all road construction work.

09405 BELT CONVEYORS

1. **Guards.** Adequate safeguards shall be provided at all points along every conveyor.

2. **Making Adjustments.** The conveyor shall always be shut down before any maintenance or adjustments are attempted.

3. **Locking Controls During Repairs.** When any repair is being made remote from the controls of the paver, adequate warning signs or locking devices shall be placed, and these shall be removed only by the repairman himself after completion of the job.

Subsection B

CONCRETE CONSTRUCTION

09421 FORM BUILDING AND ERECTION

1. **Housekeeping.** Good housekeeping shall be observed at each new concrete structure. Materials and tools shall be kept picked up, and special care shall be taken that no boards with protruding nails are allowed to lie around.

2. **Protective Apparel.** All workmen placing

concrete shall wear protective hats wherever the hazard of overhead falling objects exists. Shirt sleeves should be rolled down, gloves should be worn, and every reasonable precaution taken to keep cement and concrete off the skin. Men required to stand in fresh concrete shall be provided with watertight boots.

3. Safety Belts. Men placing reinforcing steel where there is a falling hazard shall be equipped with lifelines and safety belts, firmly secured, with a maximum slack of 4 feet.

4. Supports. While concreting there should be one carpenter, or more if necessary, assigned to tighten wedges and to see that centering supports are not in danger of collapsing. Mud sills should be used on all shoring that rests on the ground, and shoring should be properly placed.

5. Temporary Scaffolds. Before decking has been put in place on joists, temporary scaffolding shall be erected as necessary to enable men to work safely. Workmen must be particularly careful not to walk out on cantilevered members of the form framing.

6. Column Forms. Men erecting column forms shall always install back braces and side braces so as to prevent any movement out and away from the building. They shall also use heavy tie-wire to tie in the tops of wood column forms to the slab reinforcing steel.

7. Beam Forms. When the outside beam forms are in place, a continuous length of $\frac{3}{4}$ -inch manila rope shall be run from one set of column dowels to the next set at the outside of the building.

8. Raising Column Forms. When outside column forms are being raised from one floor level to another floor, the area below the place where the column forms are being raised should be roped off.

9. Bracing Shores. In the setting of shores, all horizontal and cross bracing should tie in all shores with the adjacent ones.

10. Concreting Equipment. Precautions to be observed by workmen using wheelbarrows will be found in article 07112.

09422 FORM STRIPPING

1. Keeping Away from Area. Only men actually engaged in stripping work should be allowed in areas where stripping is being done.

2. Concrete Must Be Set. Forms should not be removed prematurely; be sure that the concrete is properly set and that it is not frozen.

3. Supports for Centering. Before stripping forms, the centering should be well supported by shoring. Ledges should be fastened to shores to prevent the centering from falling.

4. Form Panels. When large panels are removed or handled by power equipment, rope tag lines should be fastened to the form panel to prevent the wind from swinging it against the men.

5. Cutting Tie Wires. When tie wires under tension are being cut, care should be taken to prevent a backlash which might hit the body, especially the face, eyes, or throat. Hammer and chisel shall not be used to cut tie wires.

6. Cleaning Lumber. Stripped lumber should be removed at once to a separate pile, then cleaned and all nails removed.

7. Protective Apparel. Workmen doing the work of cleaning stripped lumber should wear heavy leather gloves and heavy soled shoes which are in good condition. Safety shoes are preferred.

09423 SPOUTING

1. Towers and Chutes. Where towers and chutes are used they should be strongly built by men experienced in this work. They should be checked daily and kept in good repair.

2. Tripods. Tripods should be solidly built, using strong material.

3. Guy Wires. Spouts should be guyed so they cannot sway in the wind.

4. Cleaning. Spouts should be cleaned out at the end of each run of concrete.

5. Barricades. Spaces below spouts should be barricaded to keep people or workmen out of areas where they might be injured by falling concrete.

09424 RUNWAYS

1. Construction. Runways shall be strongly built, evenly supported, and have a smooth-running surface of sufficient width to prevent buggies from running off.

2. Support of Centering. Centering directly under runways should have extra supports.

3. Railings. Runways that are used for workmen's access shall have standard railings on open sides to protect the workmen using them.

4. Slope. Runways shall be built with such a slope that men will not slip. Cleats should be fastened to sloping runways when the incline exceeds one foot rise in a five foot run.

5. Keeping Clean. Runways shall be kept free of loose materials, ice, snow, grease, mud, and other causes of insecure footing.

09425 MIXING AND PLACING CONCRETE

1. Tripping Over Tools. Tools such as shovels and hoes shall be placed where workmen will not trip over them or bump into them. The mortar box shall be placed clear of workmen's access ways.

2. Back to Wind. When mixing concrete, workmen should stand with the wind to their backs so the dust from the dry mix will not blow into their faces and eyes.

3. Charging. When "charging" (i.e., placing sand, gravel, cement, and water in mixers), care should be taken not to miss the opening in the mixer and drop material on a passerby.

4. Batching Truck. Workmen must make sure that the dry batch truck does not back up and pin them between the skip and the truck, or perhaps even run them down. Dry batch truck drivers must exercise special care in backing up to the mixer skip to avoid injuring workmen around the skip. The driver should back up to skip only on signal from the mixer operator or the skipman if there is a skipman.

5. Catching Clothing in Moving Parts. Workmen must be careful not to get too near to moving parts, like revolving drums, cables, etc., thereby running the risk of their clothing being caught and drawing them into the machinery.

6. Dumping Load. When a transit mixer

dumps a load of concrete into a bucket, care must be taken to see that the bucket gate is closed. Cables should be checked for defects to prevent the load being dropped.

7. Guards in Place. Pipe skip guards and safety chains on the paver must be kept in place.

8. Standing Under Load. Every precaution must be taken to prevent people from standing or passing under a raised skip.

09426 CONCRETE BUGGIES

1. Keep Clean. Concrete buggies shall be kept clean and in good repair.

2. Handles Guarded. The handles of concrete buggies should not extend beyond the wheels of either side. The handles of buggies should be equipped with knuckle guards.

3. Stop Cleats for Dumping. Stop cleats should be used at all places where buggies are dumping material.

4. Balancing Load. Loose weights should not be hung on the handles of buggies to act as counter balances; the load should be trimmed if possible. If weights become necessary, they shall be securely fastened to the handles.

5. Moving Load of Concrete. Workmen should not try to move too heavy a load of concrete, nor try to wheel a load over ramps that are insecure, narrow, or rough.

6. Danger of Backing Trucks. Workmen using buggies around concrete mixers shall be alert to see that a truck does not back up and pin them between the mixer and the truck.

Section 5

STEEL ERECTION

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09501 OBJECTIVE AND SCOPE

1. **Hazards.** Erecting steel is one of the most hazardous jobs in the construction field. Much depends on the skill and good judgment of the workmen; but many injuries will be prevented if the men realize fully the extent of the danger accompanying this work and learn to observe these precautions daily as one of the basic requirements of their job.

2. **References.** The erection of steel requires the extensive use of cranes, derricks, hoists, ropes and slings. Precautions covering such equipment will be found in section 2 of this chapter.

09502 GENERAL

1. **Protective Apparel.** Workmen employed on steel erection operations shall wear protective hats at all times. They should wear stout shoes (safety shoes are preferable), gloves and overalls without cuffs. They should wear safety belts when working 12 feet or more above the floor, and at all times when working over water or doing repair work on a ship's sides.

2. **Goggles.** Goggles of approved type shall be worn by workmen employed in cutting out rivets, caulking, burning, grinding, chipping, or similar operations.

3. **Welding.** Welding operations shall be shielded or screened when necessary for the safety of the workmen or others in the vicinity.

4. **Fresh Paint.** Workmen shall not work on steel members which have been freshly painted.

5. **Hoisting Material.** Material shall not be hoisted to a structure until it is ready to be put into position and fastened.

6. **Load Falls.** There shall be at least two parts in the load falls used in steel erection.

7. **Steel Cables.** Steel cables shall be used on all loads in steel erection. When hoisting steel a guide rope should be attached to guide the load until it reaches the level where it is to be erected.

8. **Bolting Steel.** In setting steel, each piece shall be securely bolted before the line is taken off.

9. **Hoisting Workmen.** Workmen shall not be lowered or hoisted in tackle or runner lines or on a load.

10. **Temporary Wiring.** Particular care shall be taken in the stringing of any temporary electric wiring coming in contact with steel. Wire with defective insulation shall not be used.

11. **Keep Tools in Boxes.** All rivets, bolts, nuts, dollies, wrenches, other tools, and other loose articles shall be kept in kegs or boxes so that vibration will not cause them to creep and fall through or over the edge of planking. All boards, planks, kegs, and other loose material shall be secured before leaving the job.

09503 RIVETING

1. **Throwing.** Hot rivets shall never be thrown across shaftways or toward the outside of a building. When riveting is done on outside walls, the rivets shall be passed by hand or thrown parallel to the wall.

2. **Catching.** Rivet catchers should use cone shaped buckets, pails, or cans of durable construction with wooden bottoms.

3. **Slings for Dollies.** Canvas, leather, or rope slings should be used for riveting dollies. Chain slings should not be used. The wire attachment on the rivet gun should not be allowed to become worn so that it may allow the tool to fly with the air pressure.

4. **Rivet Heaters.** A pail of water for fire extinguishing shall be kept at every rivet heater.

5. **Floor Requirements.** The riveting gangs and painters shall have a fully planked floor not more than two stories below them.

6. **Erection Ahead of Riveting.** When the columns are two or more stories in height the erection gang shall not be more than four stories above the riveting gangs. Where the column splices are at every story the distance between the erection gang and the riveting gangs shall not be more than two stories.

09504 WORKING FLOORS

1. **Temporary Floors.** The working floor, i.e., the floor on which the structural steel is being erected, shall be planked over solidly. The planking shall not be less than two inches thick

(nominal thickness) and shall be laid close, so that nuts and bolts cannot slip through. The overlap shall be four inches or more. The planks shall be placed so they cannot tip under the weight of the worker at any point, and so secured that they cannot slip out of place. All planking shall be sound, good quality material.

2. **Loading Temporary Floors.** All steel members deposited on temporary flooring shall be distributed so as not to exceed the safe carrying capacity of the floor.

3. **Permanent Floors.** In structural steel buildings the permanent floor construction shall be put in as the building progresses, and as closely behind the erecting, riveting, and painting as may be practicable. In no case shall the steel erection be more than eight stories above the uppermost permanent floor filling.

09505 SAFETY NETS

Where it is impracticable to provide temporary floors on structures, as in theaters, auditoriums, and other such large open areas, rope nets shall be suspended below the points where men are working, or safety belts and lifelines (with a maximum slack of 4 feet) shall be provided to keep workmen from falling.

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United States Navy
SAFETY PRECAUTIONS

Chapter 10
SCAFFOLDS AND PLATFORMS

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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10101 DEFINITIONS

1. **Scaffold.** The term "scaffold" shall mean any temporarily located elevated platform used for supporting workmen and materials in the course of any and all types of construction work, including excavation, construction, erection, alteration, demolition, maintenance, repair, and all operations in connection therewith. Suggested methods of design and construction of the various types of scaffolds are illustrated in section 5 of this chapter.

2. **Barge (Pontoon) Scaffold.** The term "barge" or "pontoon" scaffold shall mean a scaffold of the independent pole type built upon and secured to a barge or pontoon for work on the hull of water-borne ships.

3. **Boatswain's Chair.** The term "boatswain's chair," illustrated in 10507, shall mean a seat to support a person in a sitting position at an elevation.

4. **Bricklayer's Square Scaffold.** The term "bricklayer's square scaffold," illustrated in 10506, shall mean a scaffold, the platform of which is composed of planks supported on built-up squares, secured to each other by diagonal bracing.

5. **Carpenter's Bracket Scaffold.** The term "carpenter's bracket scaffold," illustrated in 10509, shall mean a scaffold, the platform of which is composed of planks and supported on triangular-brace brackets secured to the side of the building.

6. **Crawling Board or Chicken Ladders.** These terms shall mean a plank or board to which cleats are nailed at equal intervals. This board is used for crawling up or down steep inclines.

7. **Float (Ship) Scaffold.** This scaffold shall mean one hung from an overhead support by means of ropes and consisting of a platform of

planks fastened together by a diagonal board underneath the platform, resting upon and securely fastened to two parallel plank bearers at right angles to the span.

8. **Horse Scaffold.** The term "horse scaffold," illustrated in 10505, shall mean a scaffold, the platform of which is supported by horses.

9. **Independent Pole Scaffold.** The term "independent pole scaffold," illustrated in 10501-2, shall mean a scaffold supported from the base by a double row of uprights and independent of support from the walls. A pole scaffold is constructed of poles, ledgers, bearers, and diagonal bracing. (An independent pole scaffold may also be referred to as a build-up scaffold.)

10. **Ladder-Jack Scaffold.** This term shall mean a scaffold, the platform of which is supported by jacks attached to ladders (illustrated in 10509).

11. **Needle-Beam Scaffold.** The term "needle-beam scaffold," illustrated in 10504, shall mean a scaffold consisting of a plank platform resting on 2 parallel horizontal beams, called "needle beams", which are supported by ropes from overhead.

12. **Outrigger Scaffold.** This term shall mean a scaffold, the platform of which is supported by outriggers or thrustouts from or through the wall of the building, and the inner end of which is secured inside the building. (See 10510 for illustration.)

13. **Plasterers' Inside Scaffold.** This term shall mean a scaffold constructed for light work inside a building, the platform of which is support by trestles, ladders, or a light-duty pole scaffold.

14. **Roofing Bracket.** A "roofing bracket" shall mean a bracket having sharp points that are driven into the roof to keep the bracket

from slipping. It should be supported by means of ropes over the ridge and secured to some permanent object on the far side of the roof, or by a hook over the ridge pole.

15. Single Pole Scaffold. The term "single pole scaffold," illustrated in 10503, shall mean a platform resting on putlogs, the outer ends of which are supported on ledgers secured to a single row of uprights and the inner ends supported on or in a wall.

16. Suspended Scaffold. The term "suspended scaffold" shall mean a scaffold supported from overhead. The platform is supported at more than two points by steel wire cables suspended from outriggers which are anchored to the steel or concrete frame of the building. This scaffold is equipped with a hoisting machine so that the platform can be raised or lowered.

17. Suspended Stage Platforms. A "suspended stage platform" shall mean a platform suspended from the hook of a crane or derrick or other approved mechanical weight lifting device.

18. Swinging Scaffold. The term "swinging scaffold," illustrated in 10507, shall mean a scaffold, the platform of which is supported by stirrups at not more than two points. Stirrups are suspended from overhead supports to permit raising or lowering the scaffold to the required work level.

19. Window Jack Scaffold. This term shall mean a scaffold, the platform of which is supported by a jack or thrustout which passes through a window opening. (See 10509 for illustration.)

20. Brace. This term shall mean a tie that holds one point in a fixed position with respect to another point. Bracing is a system of braces that prevents distortion of a structure such as a scaffold.

21. Building. It is intended in this section on scaffolds that this word mean ship's hull or appurtenances in addition to its ordinary meaning.

22. Heavy Duty Scaffold. This term shall mean a scaffold designed and constructed to carry a working load of 75 pounds per square foot, such as is intended for stone masonry work, construction work involving steel members, or similar construction. Such scaffolds support,

in addition to the workmen, a supply of heavy material.

23. Ledger (Stringer). The term "ledger" shall mean a scaffold member which extends horizontally from upright to upright at right angles to the putlogs. The ledgers support the putlogs, and form a tie between the uprights, and are a part of the scaffold bracing. (Ledgers which do not support putlogs are called stringers.)

24. Light Duty Scaffold. This term shall mean a scaffold designed and constructed to carry a working load of 25 pounds per square foot; such a scaffold is intended for the use of carpenters, painters, or others of a similar trade, and supports no load other than the workmen and a minimum of light-weight material.

25. Putlogs (Bearers). The term putlog shall mean a scaffold member upon which the platform rests. In a single pole scaffold the outer end of the putlog rests on a ledger and the inner end rests on or in a wall. In an independent-pole scaffold, each end of the bearer rests on a ledger.

26. Protective Covering. A protective covering is an overhead protection consisting of a roof of lumber, heavy wire screen, or heavy canvas, depending upon the hazard involved. Coverings are used to protect against falling material. Covering shall extend a sufficient distance beyond the edge of the scaffold to catch any material that may fall over the edges. The netting of screen shall be not less than No. 18 gage, U. S. Standard Wire, with a mesh not to exceed one-half inch. Screens of heavier wire or smaller mesh shall be used where conditions are such that the No. 18 gage wire or one-half inch mesh will not furnish adequate protection.

27. Side Screen. A "side screen" is a screen paneling from platform to intermediate railing or from platform to the top railing. Screening is formed of No. 16 U. S. gage wire with one-half inch mesh. Screen is used for the purpose of preventing materials, loose or piled, from falling off scaffolds.

28. Standard Guard Railing. "Standard guard railing" is a vertical barrier erected along the exposed sides of scaffolds. The barrier consists of a top rail, an intermediate rail, and an up-

right having a vertical height of 42 inches measured from the upper surface of the top rail to the platform. The intermediate rail should be located approximately half way between the top rail and the platform. The intermediate rail may be of fibre or steel rope, pulled up taut and of strength equivalent to that of a wooden rail. The guardrail shall be of dressed lumber, straight-grained and not less than $1\frac{7}{8}$ inch by $2\frac{7}{8}$ inches in size.

29. Standard Toe Board. A "standard toe board" is a vertical barrier at platform level, erected along the exposed edges of a scaffold platform to prevent materials falling off. The height of toe board shall be at least 6 inches.

30. Square. The term "square" shall mean a frame structure built up of vertical and horizontal members and braces which, when used in pairs and set up and braced longitudinally, provides a support for a working platform. (See 10506 for illustration.)

10102 MISCELLANEOUS PRECAUTIONS

1. Use of Scaffolds. Scaffolds constructed in accordance with Navy requirements should be provided for personnel engaged in work that cannot be done safely from the ground or from other solid construction, except such short-period work as can be done safely from securely placed ladders.

2. Makeshift Scaffolds. Scaffolds of a type suitable for the work shall be provided for the safety of the personnel performing such work. The use of "shore", "lean-to", or other makeshift scaffolds is prohibited.

3. Maintenance. All scaffolds and scaffold equipment mentioned or described herein shall be maintained in a safe condition and shall not be altered or disturbed while in use. Personnel shall not be allowed to use damaged or weakened scaffolds.

4. Inspection. Structural members, support ropes, and scaffold equipment shall be inspected daily before work is started.

5. Protective Covering. When men are working on a scaffold with other workmen engaged directly above, either the scaffold shall have an overhead protective covering or the workers on the lower scaffold must wear approved protective hats. Where the upper working level is no more than 12 feet above the lower,

hard hats worn by workers on the lower level will satisfy this requirement.

6. Scaffolds Over Passageways. Employees should not be required to work underneath a scaffold. Scaffolds erected over passageways, thoroughfares, or locations where employees are working shall be provided with side screens and a protective covering.

7. Access. A safe means of access shall be provided to all scaffolds by means of standard stairs or fixed ladders.

8. Construction and Dismantling. The erection, alteration, and dismantling of scaffolds shall be done only under the supervision of men experienced in scaffold work.

9. Nails. When dismantling the scaffolding, all nails shall be immediately withdrawn from the lumber and safely discarded.

10. Sway Bracing. Scaffolds shall be secured against swaying.

11. Weather Restrictions

a. WIND. Employees shall not be permitted to work on a scaffold during a storm or high wind.

b. ICE AND SNOW. Employees shall not be permitted on scaffolds which are covered with ice or snow. Clinging ice shall be removed from all guardrails, and the planking sanded or otherwise protected against slipping. Platform planking should not be turned over if it is covered with sleet, snow, or ice.

12. Improper Support. Unstable objects, such as barrels, boxes, loose tile blocks, and piles of bricks shall not be used for the support of scaffold planking.

13. Used for Storage. No scaffold shall be used for the storage of materials, except that required for the immediate needs of the job.

14. Material on Scaffold. Tools, equipment, material, and rubbish shall not be allowed to accumulate on scaffolds to a point where the safe movement of the employees is jeopardized.

15. Containers for Tools. Tools should be placed in containers to prevent their being knocked off. Containers should be secured to the scaffold by rope.

16. Bracing for Load. Scaffolds shall not be used as loading or landing platforms for material unless they have first been sufficiently braced and reinforced for such purposes.

17. **Use of Clamps.** When heavy loads, shocks, or vibrations must be resisted, bolted or patented clamp connections shall be used.

18. **Raising or Lowering Objects.** Throwing or dropping objects or tools from scaffolds is prohibited. Hand lines shall be used for raising or lowering objects when they cannot be reached easily and safely by hand. Jumping by persons or throwing material upon a scaffold platform is prohibited.

19. **Painting.** Scaffolds shall not be painted since painting conceals defects which otherwise would be apparent.

10103 SAFE LOADS

1. **Specifications.** Platforms and all supporting elements of scaffolds, whether of wood or any other material, shall be designed to support a minimum uniform load per square foot as follows:

PLATFORM LOADS

Use	Uniform load per square foot
Stone masons-----	75 pounds stone on scaffold
Stone setters-----	Heavy duty---- 40 pounds, no stone on scaffold
Bricklayers-----	
Carpenters-----	Light duty---- 50 pounds, stocked
Miscellaneous-----	
Painters and decorators-----	
Stucco workers-----	25 pounds
Lathers and plasterers-----	30 pounds, hod stocked
Lathers—precast work---	30 pounds
	weight of bay, casts, and men

NOTE.—If concentrated load is used at any point in the span, it should not exceed one-half the allowable distributed load.

2. **Safety Factor.** Scaffolds shall be capable of supporting the working load, with a safety factor of at least four. For guidance refer to Design Specifications for Stress Grade Lumber of the National Lumber Manufacturers Association.

3. **Distribution of Load.** Whenever possible, scaffold load should be uniformly distributed and not concentrated at the center of the platform.

4. **Overloading.** Scaffolds must never be overloaded.

10104 SPECIFICATIONS FOR LUMBER

1. **Thickness.** Planking shall be of uniform thickness and laid close together. Planks may be lap or butt-jointed.

2. **Width.** Scaffold platforms shall be not

less than 20 inches wide except as otherwise required by specifications herein.

3. **Kinds.** Lumber used in the construction of scaffolds shall be either spruce, Douglas fir, southern (long-leaf) yellow pine, or wood of equal strength. Hemlock, short-leaf yellow pine, or other short fibre lumber shall not be used.

4. **Condition.** Lumber shall be dressed (except scaffold plank may be rough) of good quality, reasonably straight grained, free from large and medium shakes, checks, splits, and unsound knots. The lumber shall be free also from dry rot and growth characteristics which impair its strength.

5. **Sizes.** Lumber sizes used in these requirements refer to nominal sizes.

6. **Protection.** When not in use, scaffold planks should be carefully stored and protected from the weather.

7. **Testing for Safe Load.** Scaffold planking may be sample tested by center loading with an applied load equal to four times the working load. Any sample plank selected out of a lot shall be discarded even though it withstands the load, if it sustains any partial failure or remains deformed after such test loading. Other methods of testing scaffold plank may be used if recommended by the United States Forest Products Laboratory.

8. **Marking Safe Load.** The maximum safe load and the date tested should be plainly indicated on the planking by stamping or other method. Safe loads are indicated in the following table:

Safe center loads for platform plank (in pounds)
[1,100 lbs. fibre stress ¹]

Span in feet	2 x 10 dressed to 1½ x 9½	2 x 12 dressed to 1½ x 11½	3 x 8 dressed to 2½ x 7½	3 x 10 dressed to 2½ x 9½	3 x 12 dressed to 2½ x 11½
6-----	256	309	526	667	807
8-----	192	232	395	500	605
10-----	153	186	316	400	484
12-----	128	155	263	333	404
14-----	110	133	225	286	346
16-----		116	197	250	303

¹ Values are for one plank supported at the ends, wide side of plank face up, and with loads concentrated at the center of the span. For loads uniformly distributed on the wide surface throughout the length, the safe loads may be twice those given in the table. Loads given are net and do not include weight of the plank.

10105 ROPES, LINES, AND CABLES

1. **Quality.** Ropes and cables used in suspension and swinging scaffolds shall be of the best quality steel, manila, or sisal. (See Navy Department Specifications 22R3, 2 April 1945; 21R7, 16 July 1945, and Federal Specification T-R-631, 17 June 1942.)

2. **Safety Factor.** All ropes supporting scaffolds shall be manila or sisal rope and shall have a factor of safety of at least six, and shall be inspected before being used on each job to ascertain whether they are sound and free from flaws or deterioration from contact with any solution containing chemicals.

3. **Hook Attachment.** Where ropes supporting scaffolds are not attached directly to hooks, the extension from the top block to the support shall be at least a one-half inch wire rope.

4. **Lifelines and Safety Belts.** Lifelines and safety belts shall be used when working on a boatswain's chair, and on unguarded scaffolds at heights of 10 feet and above. Manila or sisal rope used as lifelines shall be $\frac{5}{8}$ inch in diameter. See 10508 for illustration of use of lifeline for moving scaffold platforms.

5. **Cleaning Buildings.** When cleaning buildings with solutions containing chemicals injurious to hemp rope fibers, wire ropes shall be used wherever possible for swinging scaffold supports.

6. **Safety Belts.** Workmen shall be required to wear Navy approved safety belts which have been securely attached to a safety line by a mechanical safety device.

7. **Damaged Rope.** Rope which has been in contact with acid shall be immediately removed and destroyed.

8. **Fall Line.** The fall line shall be kept on the outside of the scaffold, with the free end in a box or barrel, located so that the rope will slope away from the building or structure.

9. **Open Flame.** Burning or welding, blowtorch operations, or the presence of any open flame shall not be permitted on a scaffold supported by a fibre suspension rope or sling.

Should such operation be necessary, the sling or suspension cable shall be of wire or steel.

10106 SCAFFOLD NAILS

1. **Importance.** The safety of a structure depends upon the nails as well as upon the timbers selected. The safety of a nail connection depends upon the resistance of the timber and not upon the material of the nail.

2. Nail Requirements

a. **MINIMUM SIZE.** Nails smaller than 8d common shall not be used. Nails shall be driven full length.

b. **LATERAL RESISTANCE.** The quantity and size nails used shall be determined by values in pounds for each size (as shown in the following table) and materials being used as applied to the total load to be supported.

c. **PARALLEL PULL.** Nails will not be used so that the pull is parallel to the length of the nail.

d. **SPECIAL DESIGNS.** Where special scaffold designs are required the quantity and size of nails to be used shall be in accordance with "Design Specifications for Stress Grade Lumber" of the National Lumber Manufacturers Association (1950), Washington, D. C.

*Lateral resistance in pounds per nail¹ in
Rocky Mountain Douglas Fir¹*

Size of nail-----	8d	10d	12d	16d	20d
Perpendicular ² -----	65	80	80	90	115
Parallel ³ -----	45	55	55	60	80

¹ Values for other woods such as coastal region Douglas Fir, Southern pine, and other may be 20 to 25 percent greater.

² Nails driven perpendicular to grain.

³ Nails driven parallel to grain.

3. **Spacing.** Nails should not be driven closer than one-half their length from the end of the board or nearer than one-quarter their length from the edge of a board.

4. **Clamp Connections.** When heavy loads, shocks, and vibrations must be resisted, bolted or patented clamp connections should be used.

Section 2

POLE SCAFFOLDS

All Pole Scaffolds, 10201
Specifications for Members, 10202
Single Pole Scaffolds, 10203
Independent-Pole or Built-Up Scaffolds, 10204

Barge (Pontoon) Scaffolds, 10205
Bricklayers' Square Scaffolds, 10206
Tubular Pole Scaffolds, 10207

10201 ALL POLE SCAFFOLDS

1. Foundations

a. **POLES PLUMB.** All poles or posts shall be set up plumb.

b. **FOOTINGS.** Scaffold poles shall not stand directly on the ground but shall bear on a footing of sufficient area and strength to spread the load from the poles over a sufficient ground area to prevent settlement. When the footing is of wood it should be a solid block or piece of plank not less than 1 foot square by 2 inches thick to distribute the load. The footing block shall be placed on solid ground and sufficiently below the surface to prevent displacement. The base of the pole shall be set and securely held in the center of the block.

c. **BRACING.** When a pole is set directly on a solid object such as a sidewalk, it shall be blocked or braced against movement.

2. Splicing Poles or Posts

a. **ENDS SQUARED.** When poles are spliced, the squared end of the upper section shall rest upon the squared end of the lower section, and the two ends shall be rigidly fastened together with not less than two wooden splice plates.

b. **SPLICE PLATES.** Splice plates should be at least 4 feet long and of the same width as the uprights. The plates shall be securely nailed in place on adjoining sides of the poles. The combined cross-sectional area of the splice plates shall be not less than that of the pole and the plates should be placed so that they overlap the abutting ends of the pole equally. They shall be located so as not to interfere with the nailing of ledgers or putlogs.

c. **OVERLAPPING ENDS.** In light-duty scaffolds not more than 24 feet in height, uprights may be spliced by overlapping the ends not less than 4 feet and securely nailing them together.

A substantial cleat shall be nailed to the lower section to form a support for the upper section.

d. **STAGGERING SPLICE.** Splicing shall be staggered. Adjacent uprights, either transverse or longitudinal, shall not be spliced at the same level.

3. **Bumpers as Protection.** As a protection against the impact of vehicles and personnel, the bases of uprights shall be protected from displacement by bumpers set independent of the scaffold.

4. Planking on Putlogs and Bearers

a. **LAPPING ENDS.** Each platform plank shall be of sufficient length to extend over three putlogs. Ends shall be lapped over the putlog.

b. **PLANKS OVERLAPPING.** When planks overlap, a single putlog is sufficient. The ends of both the upper and lower planks should overlap the putlog by at least 6 inches.

c. **PLANKS END TO END.** When planks are laid end to end, two parallel putlogs shall be provided not more than 8 inches apart so that one putlog will support the end of one plank and the other putlog the end of the other plank. Two successive lengths of planking shall not abut beyond a single putlog.

d. **PROJECTION OVER PUTLOG.** Planking shall project over the last putlog at the end of the scaffold by at least 6 inches, but in no case more than one foot.

e. **TURNING CORNER.** When a scaffold turns a corner, the planks shall be laid to prevent tipping. The planks that meet the corner putlog at an angle shall be laid first, and extend over the diagonally braced putlog far enough to have a good safe bearing, but not far enough to involve any danger from tipping; then the planking running in the opposite direction, at right angles, shall be laid so as to extend over and rest on the first layer of planking.

5. Ledgers

a. **SHIFTING PLATFORM.** When a platform is shifted or raised, the new ledger boards shall first be nailed to the uprights at the proper height; then the putlogs that are to support the new platform shall be set.

b. **PLACED AGAINST INSIDE FACE OF POLE.** Ledgers shall be securely nailed or bolted to each upright and, except where they interfere with the bracing, shall be placed against the inside face of the pole.

c. **NAILED LEVEL.** All ledgers shall be nailed up level. In the case of single-pole scaffolds, the top edges of the ledger shall be at the same height as the bottom of the openings in the wall which receives the inner end of the bearers, so that both bearings will be at the same level.

d. **LEAVE OLD LEDGER IN PLACE.** As the platform is raised with the progress of the work, the ledgers upon which it previously rested shall be left in place to brace and stiffen the upright until the scaffold is dismantled.

e. **OLD PLATFORM.** The old platform shall be left undisturbed until the new putlog has been set in place. Also, until the working platform is entirely planked over, it is advisable to leave a platform two or three tiers below the working platform, to lessen the severity of injury should men fall, and as a protection to persons below from falling materials.

f. **OVERLAP.** Ledgers shall be long enough to extend over two upright pieces and should overlap the poles by at least 4 inches. Where two ledgers overlap on the same upright, each shall be securely fastened; one first being nailed to the upright, and then the outer one nailed to and through the inner one. Nails should be kept distributed.

g. **SPLICING.** In heavy-duty scaffolds, the combined cross-sectional area of the spliced plates shall not be less than the cross-sectional area of the ledger. The splice plates shall be so placed as to overlap the abutting ends of the pole equally and shall be so located as not to interfere with the nailing of ledgers. Ledgers shall always be spliced at poles.

h. **LEDGERS AT RIGHT ANGLE.** When two ledgers meet at right angles on a pole, one shall be fastened on the inside and its end cut off flush

with the face of the pole, and the other fastened on the outside and overlapping the inside one.

i. **REINFORCING LEDGERS.** Ledgers supporting heavily loaded platforms shall be reinforced by bearing plugs, braces, or cleats securely nailed to the side of the pole, forming a support for the ledger.

6. Bearers or Putlogs

a. **GREATER DIMENSION VERTICAL.** Bearers and putlogs shall be set with their greater dimension vertical, and shall be long enough to project at least 3 inches over the ledger beyond the outer row of poles, and the same distance beyond the inner row (of independent pole scaffolds).

b. **SUPPORT.** Bearers shall be supported on the ledger located against the sides of the pole and nailed to both the pole and ledger. Where intermediate bearers are used for the support of planking, the ledger shall be reinforced as necessary.

7. Bracing of Scaffolds

a. **DIAGONAL BRACING.** Diagonal bracing shall be provided to prevent the poles from moving in a direction parallel with the building, or from buckling.

b. **BETWEEN INNER AND OUTER UPRIGHTS.** Cross bracing shall be provided between the inner and outer sets of poles in independent-pole scaffolds.

c. **FREE END BRACING.** The upper free ends of pole scaffolds shall be cross-braced.

d. **AWAY FROM BUILDING.** Braces which are used for the purpose of holding the scaffold at a fixed distance from the building shall be secured to the pole.

e. **HIGH SCAFFOLDS.** Scaffolds which extend to a height of more than 40 feet and support heavy loads of material shall be thoroughly and substantially braced.

8. Guard Rails

a. **OPEN SIDE.** A standard guardrail and toe-board shall be provided on the open side of the platform on all single-pole and independent-pole scaffolds.

b. **BUILDING SIDE.** If the space between the scaffold and building is more than 18 inches, a standard guardrail shall be erected on the building side.

10202 SPECIFICATIONS FOR MEMBERS

Minimum nominal dimensions of lumber and spacing of members for single pole and independent pole scaffolds for various loadings are given in the following tables. See also paragraphs 10103-10106 for specifications on scaffold plank, loading standards, and nailing details. Illustrations and identifications of members will be found in 10501, 10502, and 10503.

*Minimum dimensions of lumber for pole scaffolds*¹
(Load in pounds per square foot)

Member	Single pole and independent pole,	Single pole,	Independent pole—	
	25 lb. load	25-75 lb. load	50 lb. load	75 lb. load
	Inches	Inches	Inches	Inches
Poles:				
24 ft. or less--	2 x 4	3 x 4 or 2 x 6	3 x 4 or 2 x 6	3 x 4 or 2 x 6
24 ft. to 40 ft.	3 x 4 or 2 x 6	4 x 4	4 x 4	4 x 6
Over 40 ft.----	(2)	(2)	(2)	(2)
Ledgers-----	2 x 6	2 x 8	2 x 8	2 x 8
Stringers-----	1 x 6	1 x 6	2 x 8	2 x 8
Putlogs (bearers)---	4 x 4 or 2 x 6 on edge	4 x 4 or 2 x 8 on edge	2 x 8	2 x 8
Braces-----	1 x 4	1 x 6	1 x 6	1 x 6
Planking-----	2 x 10	2 x 10	2 x 10	2 x 10
Toeboards-----	1 x 6	2 x 6	2 x 6	2 x 6
Guardrails-----	2 x 4	2 x 4	2 x 6	2 x 6

¹ See loading standards, 10104.8.

² Pole scaffolds over 40 feet in height shall be designed by a qualified engineer in accordance with "Design Specifications for Stress Grade Lumber," of the National Lumber Manufacturers Association (latest revision), Washington, D. C.

Spacing of scaffold members

Member	25 lb. per sq. ft. load	25-75 lb. per sq. ft. load
All pole spacing (longitudinal).	7 ft. 6 in. maximum.	7 ft. maximum.
Independent pole spacing (transverse):		
24 ft. or less-----	6 ft. 6 in.-----	6 ft. 6 in.
24-40 ft.-----	7 ft. 6 in.-----	10 ft.
Single pole spacing (from wall).	3 ft. to 5 ft.-----	3 ft. to 5 ft.
Ledger spacing (vertical).	7 ft. maximum.	4 ft. 6 in. maximum.

10203 SINGLE POLE SCAFFOLDS (See 10503)

1. **Ledgers as Braces.** Ledgers shall be left in place to brace the scaffold after platform planks are removed.

2. **Putlogs.** In a single-pole scaffold the inner end of the putlog shall rest in the wall of the building with at least a 4-inch bearing. The putlog shall not be notched out or cut down, except in alteration or light repair work, when it may be notched or cut down to fit into a space made by the removal of a brick. In such cases, the notch shall be made on the upper side of the putlog and only deep enough to permit its being inserted in the hole in the wall.

3. **Spring Staybraces.** When putlogs are removed in single-pole scaffolds, spring staybraces shall be inserted to take their place, and shall be located in at least every alternate upright of every row of putlogs. When a brick is inserted for holding the two boards of a spring stay apart, it should be kept near the wall to ensure a good grip of the brace in the hole of the brick work.

4. **Attached to Frame Building.** When the inner end of a putlog is attached to a frame building a piece of lumber, not less than 2 x 6 x 12 inches, shall be notched out the width of the putlog and not less than 2 inches deep, and nailed to the side of the building to form a bearing.

5. **Securing Putlog.** The end of the putlog shall rest on the bearing and shall be nailed to both the bearing and the building.

6. **Window Sill Support.** When the inner end of a putlog goes through a window opening, it shall be supported on a thick plank or other support resting on the window sill. The support shall be securely braced against displacement.

10204 INDEPENDENT POLE OR BUILT-UP SCAFFOLDS

1. **Specifications.** See 10202 for dimensions and spacing of members and 10501, 10502 for illustrations.

2. **Placing Inner Poles.** The inner row of poles shall be set as near to the building as practicable.

able and still allow workmen ample working space.

3. Bracing Poles

1. The outer row of poles should be connected by diagonal braces at an angle of about 45° .
2. The bracing shall be securely fastened to the pole by a sufficient number of nails.
3. Diagonal braces should run up across the entire face of the scaffold in both directions. Braces should be spliced at the poles.
4. In very high or heavy duty scaffolds, the inner row of poles should also be braced in the manner described in the preceding paragraph.

10205 BARGE (PONTOON) SCAFFOLDS

1. **Purpose.** Scaffolds shall be constructed to ensure adequate rigidity under sudden surges, such as those caused by water swells.

2. **Weather Restrictions.** Personnel shall not be permitted on a barge scaffold in rough weather.

3. **Dock Trial Restrictions.** During dock trial of a ship, barge scaffold work shall not be permitted.

4. **Safety Belts.** Safety belts, secured to scaffold, shall be worn by personnel if "rocking" of scaffold is severe enough to make it difficult to maintain proper balance at all times.

5. **"Camels."** When working between two ships or between ship and dock, "camels" shall be provided to prevent crushing of barge through movement of the vessels.

6. **Ships' Engines Secured.** Before men are permitted to perform work from a scaffold at or near the stern of a ship, definite assurance must be obtained by the hull superintendent from the officer of the deck that the ship's engines have been secured. When possible, barge shall be kept clear of propellers.

7. **Wood Constructed.** When barge scaffolds are constructed of wood, the following table shall govern:

Poles.....	4 in. x 6 in.
Putlogs.....	3 in. x 6 in.
Splices.....	2 in. x 6 in.
Braces.....	1 in. x 8 in.
Pole spacing (longitudinal).....	7 ft. to 10 ft.
Pole spacing (transverse-bottom).....	12 ft.
Pole spacing (transverse-top).....	8 ft. to 10 ft.
Planking.....	2 in. x 10 in.
Height between platforms.....	8 ft.

8. **Tubular Pole.** Tubular pole scaffolds shall be erected in accordance with "Tubular Pole Scaffolds" requirements in 10207.

9. Proportional Dimensions

a. **WIDTH.** In no case shall the over-all width of the erected poles be more than 80 percent of the width of the barge upon which it is erected.

b. **LENGTH.** The distance between end poles shall not exceed 80 percent of the barge length.

c. **HEIGHT.** The height of the working platform shall not be greater than the over-all distance between the end poles.

d. **WEIGHT.** Weight of scaffold shall not constitute more than 50 percent of the total displacement of the barge scaffold system.

e. **LIST.** The maximum working load concentrated at the greatest point of leverage shall not cause the barge scaffold to list more than 3° . Ballast may be employed to correct this list.

10. Center of Gravity

a. **KEEP LOW.** The combined center of gravity of the barge and scaffold shall be kept as low as possible.

b. **LINE OF BUOYANCY.** The combined center of gravity of the barge and erected scaffold shall be in the same vertical line with the center of buoyancy when the barge with scaffold is floating in still water. If necessary, ballast permanently secured to barge may be used to effect this condition.

c. **METACENTRIC HEIGHT.** The height of the scaffold and the length of the cantilever putlogs beyond the inboard poles shall be limited to those distances which will ensure a metacentric height sufficient for adequate initial stability or "righting arm".

11. Attaching Scaffold to Barge

a. **ANGLE CLIPS.** All poles shall be firmly se-

cured to the deck of the barge by means of two 6-inch by 6-inch angle clips.

b. **CENTERED.** Poles shall be centered on the barge in all directions.

c. **BOLTS.** Clips shall be welded or bolted, as appropriate, to the deck, and so spaced that the backs fit snugly against the 6-inch side of the uprights. They shall be bolted in this position, from one to the other through the uprights, by not less than three nor more than four ½-inch galvanized steel bolts. Bolts shall be equipped with lock washers.

12. Requirements for Barges

a. **FREE BOARD.** Barges upon which a scaffold is erected shall have a minimum of 1 foot of free board.

b. **DESIGN.** Barges shall be of an approved design and shall be thoroughly seaworthy in every detail.

c. **DECK FITTINGS.** Barges shall be equipped with such deck fittings as will permit proper maneuvering and mooring.

d. **HATCH COVERS.** Hatch covers shall be equipped with rubber gaskets and dogs. Covers shall be firmly battened down except when opened for entering or leaving a hull.

e. **FENDERS.** Barges shall be equipped with fenders.

f. **HULL.** Barge hull shall be maintained in a watertight condition.

g. **ALONGSIDE SHIP.** When in position alongside of ship the barge shall be secured to ship.

h. **PLATFORMS.** Standard guardrails and toe-boards shall be provided along the sides of the platform not used for performing work.

i. **WIDTH OF GAP.** The gap between the working platform's edge and the ship's hull shall not exceed 1 foot.

j. **LIFE RING.** At least one life ring shall be provided on a barge.

10206 BRICKLAYERS' SQUARE SCAFFOLDS (See 10506)

1. Dimensions

a. **TIERS.** When this type of scaffold is used, it shall be built up not more than three tiers or squares high. The tiers shall be braced together both front and rear, to give stability and rigidity.

b. **DETAILS.** The squares shall be of clear material not larger than 5 feet on each side and shall be framed as shown in 10506. The main members shall be 2 by 4 with top and bottom members overlapping the uprights. The corner braces shall be 1 by 6 and the main diagonal braces shall be 1 by 8.

2. Bracing

a. **CROSS BRACING.** Cross bracing shall be placed laterally from the bottom of each square to the top of the adjacent squares. Such bracing shall be 1 by 6 material.

b. **SIDE BRACING.** The squares shall have 1 by 6 lateral side braces on both sides running from the center of each member to the center of the adjacent member.

3. Spacing Squares

a. **DISTANCE BETWEEN.** The squares shall be spaced not more than 5 feet apart on heavy-duty scaffolds and not more than 8 feet apart on light-duty scaffolds.

b. **SUPERIMPOSED.** When erected in squares the squares shall be placed one directly above the other.

4. **Support of Scaffolds.** The scaffolds shall be set up on a level and unyielding foundation.

5. Planking

1. The upper tier shall stand on continuous rows of planks laid across the lower tier.

2. Planks shall be nailed or cleated.

3. Each plank should extend over three squares.

4. The ends of planks shall overlap the squares by at least 4 inches and not more than 6 inches.

10207 TUBULAR POLE SCAFFOLDS

1. **Material Used.** The scaffold members shall be of galvanized steel tubing or other noncorrosive metal of equal strength.

2. **Locking Device.** All vertical and horizontal members of a scaffold shall be fastened together with a coupler or approved locking device forming a positive connection to prevent movement of the scaffold when in use. The locking device shall be of a type having no loose parts.

3. **Material Used in Locking Device.** The locking device or coupler shall be of drop-forged steel, galvanized, or material of equal strength

and corrosion resistance. Use of gray cast-iron fittings is prohibited.

4. Dimensions of Members. In the construction of tubular pole scaffolds members of the following dimensions should be used:

Member	Light-duty	Medium-duty	Heavy-duty
Pole.....	2 in. O. D.	2 in. O. D.	2 in. O. D.
Putlog.....	2 in.	2½ in.	2½ in.
Runner.....	2 in.	2 in.	2 in.
Bracing.....	2 in.	2 in.	2 in.
Pole Spacing			
longitudinal..	10 ft.	8 ft.	6 ft. 6 in.
transverse ..	6 ft.	6 ft.	6 ft.

NOTE.—For scaffolds up to 75 feet in height, poles or 2-inch O. D. tubing, as per table, should be used. For heights 75 feet to 200 feet, 2½-inch O. D. tubing shall be used.

5. Safety Factor. Scaffolds shall be designed to have a factor of safety of not less than four.

6. Putlogs

a. ATTACHING. Tubular putlogs shall be placed at right angles to the runners and attached thereto with couplers.

b. LOCATION. Putlogs shall be located at each set of uprights and at each level including intermediate levels where working platforms are installed.

c. OVERHANG. Putlogs shall overhang at least 10 inches beyond the inside and outside uprights.

d. PITCH. The putlogs should have a slight downward pitch towards the building wall.

e. CLINCHER PLATE. In the case of single-pole tubular scaffolds, the putlogs should be equipped on the inner end with a ¾-inch steel clincher plate which hooks into the vertical brick joint.

7. Runners

a. LOCKING. The tubing forming the runners shall be locked end to end with fittings and secured to each intersecting upright with couplers.

b. LEVELING. The bottom runner shall be leveled both lengthwise and crosswise.

c. PROPER HEIGHT. When attaching the upper runner, the couplers should first be located at the proper height on the upright by means of a measuring stick.

8. Bracing. Tubular bracing shall be applied both lengthwise and crosswise, as required.

a. LENGTHWISE. Lengthwise bracing shall be located on the outer face of the scaffold and secured to the projecting ends of the putlog with couplers, or in some other approved manner.

b. CROSSWISE. Crosswise bracing shall be located on every fourth or fifth set of poles and attached with couplers to the runners at alternate levels.

c. KEEPING SCAFFOLD PLUMB. The scaffold shall be kept plumb and rigid by means of adequate bracing.

9. Poles

a. KEEP PLUMB. Poles shall be kept plumb during erection.

b. FIRM FOUNDATION. Poles shall be fitted with bases supported on a firm foundation or on sills to distribute the load. When wooden sills are used, the bases shall be fastened thereto.

c. CASTERS. On interior portable rolling scaffolds, the foot of the pole shall be equipped with wheels or casters, especially made for this purpose, which are capable of being positively clamped or locked to prevent rolling.

d. ADJUSTABLE COUPLERS. At the foot of poles where there are no horizontal runners or putlogs to attach to, adjustable couplers shall be used for attaching the bracing to the poles.

Section 3

SUSPENDED SCAFFOLDS

Suspended Scaffolds, 10301
Suspended Stage Platforms, 10302
Boatswains' Chair, 10303
Float (Ship) Scaffolds, 10304

Interior-Hung Scaffolds, 10305
Masons' Swinging Scaffolds, 10306
Needle-Beam Scaffolds, 10307
Outrigger Scaffolds, 10308

10301 SUSPENDED SCAFFOLDS

1. **When Used.** The use of a suspended scaffold is recommended for all buildings more than five stories high to which outriggers can be adequately fastened. The parts of the building or structure to which a suspended scaffold is attached shall be examined to determine if such parts are of sufficient strength to support properly and safely the load that will be applied to the scaffold.

2. **Approved Type.** Scaffold machines shall be of a design approved by the Underwriters Laboratories.

3. **Never Used for Heavy Material.** Suspended scaffolds shall never be used for the storage of stone or heavy materials.

4. **Workload.** Suspended scaffolds shall be capable of sustaining a working load of 40 pounds per square foot.

5. **Webs Vertical.** All beams and channels shall be set with their webs vertical.

6. **Hoisting Machine.** Suspended scaffolds shall be provided with a hoisting machine of either the platform or overhead type.

7. **Experienced Men.** Experienced men only shall be permitted to operate the machine.

8. Outriggers

a. **ANCHORING.** The outriggers should consist of steel I-beams, each securely anchored to the framework of the building by U-bolts and anchor plates or other equally safe means.

b. **CHANNEL IRONS.** If channel irons are used instead of I-beams, they shall be in pairs, placed back to back and fastened together with belts or clamps. Where greater bearing width is required, pipe separators may be used.

c. **STRENGTH.** The outriggers shall be equivalent in strength to standard 7 inch-15.3-pound I-beams and shall be at least 15 feet long.

d. **PROJECTION.** The outriggers shall project at least 1 foot beyond the outer edge of the suspended platform.

e. **STOP-BOLT AT END.** A stop-bolt shall be placed at the outer end of every outrigger.

f. **SECURING.** When the inner end of the outrigger extends inside the building, it shall be secured to the building structure.

g. **PLACING SHACKLES.** The shackle supporting the outside cable shall be placed not more than 6 feet beyond the bearing point of the outrigger on a 4-foot scaffold; and the shackle supporting the inner cable shall be placed not more than 2 feet beyond the bearing point of the outrigger. When the platform is wider than 4 feet, the inner and outer suspension cables shall be so located as to hang vertically.

h. **RAISING OUTRIGGER.** When it is necessary to raise the outrigger above the supporting beam, it shall be blocked up on the supporting beam with steel or hardwood blocking.

i. **SUPPORT FOR PLATFORM.** When platforms wider than 4 feet are required, the strength of the outriggers shall be increased accordingly.

9. Bearers

a. **DIMENSIONS.** The platform bearers shall be of steel, not less than a pair of 2 by 2 by $\frac{3}{16}$ -inch standard angles, or other sections of equivalent strength. If wooden bearers are used, they shall be of long leaf yellow pine, not less than 4 by 6 inches. Wood of equivalent strength can be used, with the greater dimension vertical.

b. **SUPPORT FOR HOISTING MACHINE.** The supporting frame of the hoisting machine shall be bolted to the bearers at the outer and inner ends with bolts not less than $\frac{5}{8}$ inch in diameter.

c. **LENGTH.** The bearers shall be of sufficient length to receive at least six 8-inch planks with the inner and outer row of planks passing

through the supporting frame of the hoisting machine.

d. **PLANKS.** The platform planks shall be laid close together and overlap the bearers at each end of the scaffold by not more than 18 inches.

e. **CONNECTIONS.** When conditions arise where the use of the standard U-bolt connection is not practical, the beam clamp connection should be used.

10. Cables

a. **CONNECTION.** The lower end of the supporting cable shall be secured to the hoisting machine by passing the end of the cable through a hole in the drum and securely fastening it by a clip; or by passing it through a hole in the web of the ratchet wheel, and making a socketed connection.

b. **PREVENTION OF SWINGING.** Strap-iron hooks shall be wired to the suspension ropes near the platform level and hooked onto the building to prevent the scaffold swinging away from the building. Fenders shall be used, consisting of pieces of plank nailed to the platform and projecting inward towards the building.

c. **TERMINALS.** The upper ends of the cables shall terminate in a spliced loop in which a steel ring or eye is inserted. The bolt passing through the shackle and ring shall be drawn up tight by a nut and lock-nut.

d. **SECURED TO OUTRIGGERS.** The suspension cables when fixed at their upper ends shall be secured to the outriggers by wrought-iron shackles and bolts.

e. **STEEL ROPE.** Steel wire ropes should be used for the support of suspended platforms in preference to steel ribbons or chains. Such ropes shall have a breaking strength of not less than 5 tons.

f. **HANGING VERTICAL.** As a guide in determining the width of the platform, the suspension cables should hang as nearly vertical as possible.

11. **Safety Belts.** Every man going out on an outrigger shall be provided with and shall wear a safety belt, to which shall be attached a lifeline securely fastened to the building. The lifeline shall be only of sufficient length to permit the work on the outrigger to be performed, and so that in the event of a fall, the fall will be broken as quickly as possible.

12. **Inspection of Bolts.** Frequent inspection shall be made to see that the threads on all bolts are perfect, that the nuts fit, and that the cable clamps are securely fastened to the outriggers.

13. **General Inspection.** All parts of a suspended scaffold shall be inspected daily.

14. **Side Screen.** The space between the toe board and the guard rail shall be filled with 16-gage, 1½-inch mesh wire netting.

15. **Working Parts Exposed.** All working parts of scaffold machines shall be left exposed so that defective parts or irregular working of the machine can be easily detected.

10302 SUSPENDED STAGE PLATFORMS

Suspended stage platforms shall not be rigged to a marine derrick or other weight-lifting device when it is practicable to use other types of staging.

1. **Not Rigged to Derrick.** A suspended-stage platform shall not be rigged to a marine derrick or other weight-lifting device when wave action will disturb the steadiness of the platform.

2. **Members of Steel.** The foundation members of a suspended stage platform shall be of structural steel. Channels, angles, T, H, or I-beams may be used.

3. **Member At Center of Gravity.** In the construction of the platform frame, in addition to the members placed at each end, a member shall also be placed on the center of gravity of the platform. (Center of gravity is that for the designed platform without load and counterweight.)

4. **Wire Rope.** Approved wire rope connections shall be used.

5. **Safety Factors and Tests.** The frame shall be capable of supporting a load equal to four times the maximum working load. When testing, the load should be applied at the diagonal corners with the frame balanced over a fulcrum.

6. **Sling Legs.** Sling legs shall support platform at each corner at the counterweight end and at a point on each side of frame as near as is practicable to the end of the platform used by the employees.

7. **Testing Crane and Boom.** Before platform

is actually used, a test shall be conducted to determine the stability of the crane or derrick and the safe working radius of the boom with the working load on the platform.

8. **Boom Radius.** Under actual use, the boom radius shall not be increased beyond that found to be safe.

9. **Qualified Operator.** The hoisting, lowering, and lateral movement of suspended platforms shall be under the direction of qualified riggers. They shall give all signals to crane or derrick operators.

10. **Determining Overturning Moment.** In the design of a suspended-stage platform, the overturning moment shall be determined on the basis of the maximum number of employees at work on the platform at any one time, concentrated at one end. This concentrated weight, times its distance from the fulcrum legs of the sling, shall be not more than one-fourth of the weight of the counterweight times its distance from the fulcrum.

11. Wire Rope Slings

a. **SAFETY FACTOR.** Suspended-stage platforms and wire rope slings shall be designed so that the strength is equal to the working load with a safety factor of four.

b. **ATTACHING SLINGS TO PLATFORM.** Approved methods shall be provided for attaching wire rope slings to platform frame.

c. **SPECIFICATIONS.** Wire rope slings shall be of 6 by 19 improved plow steel and shall not be less than $\frac{3}{4}$ inch diameter.

d. **LIMITED USE.** Wire rope slings used for supporting a platform shall not be used for any other purpose.

e. **PLATFORM SUSPENDED.** The platform shall be suspended from a four-legged wire rope sling.

12. **Planks Bolted to Frame.** Platform planks shall be bolted to the frame. Bolt heads shall be counter-sunk.

13. **Guardrails.** Suspended-stage platforms shall be equipped with either pipe or angle-iron standard guardrails and toe boards along such portions of each side and end not actually used for performing the work.

14. **Hooks Moused.** Hooks used for suspended-stage platforms shall be adequately moused.

15. **Guide Lines.** Tag or guide lines, used for steadying or keeping suspended platforms in

position, shall be attended by an experienced tradesman.

16. **Use of Platforms as Elevators.** Platforms shall not be used for the elevation of employees, materials, or equipment other than that determined to be needed for the immediate job.

17. **Counterweights.** A counterweight shall be of iron or concrete. It should be placed and secured at a point at least 12 inches from the end of the platform, opposite the end which will be used by the employees.

18. **Life Rings.** At least two life rings shall be attached to platforms suspended over water.

19. **Boarding Platforms.** Employees shall board and leave platforms at designated places.

20. **Jumping on Platforms.** Jumping on or off platforms is forbidden.

10303 BOATSWAINS' CHAIR (See 10507)

1. **Dimensions of Chair.** The chair shall be a seat not less than 2 feet long and 1 foot wide by $1\frac{1}{4}$ inches thick.

2. **Cleats.** Where practicable, cleats should be screwed to the underside of each end of the chair and project at least 9 inches in front of the seat.

3. **Suspension Rope.** The chair shall be supported by means of a sling attached to a suspension rope. This rope shall either be securely fastened to a fixed object overhead or pass through a securely fastened overhead block. The free end shall be fastened to a fixed and easily accessible object.

4. **Strength of Sling.** The sling shall be of at least $\frac{5}{8}$ -inch diameter manila rope, or its equivalent in strength.

5. **Stirrups.** When the free end of the suspension rope is attached to a pole by means of a hitch, the workman shall be provided with stirrups upon which he can rest his weight while he is shifting the hitch.

6. Safety Belt

a. **LIFELINE.** Every workman using a chair shall be provided with a safety belt. The safety belt shall be attached to a lifeline secured to a fixed object.

b. **FREE END OF ROPE.** A bowline knot should be used to secure the free end of the rope.

7. **Open Flame.** Burning and welding, blowtorch operations, or the presence of any open flame shall not be permitted on or near a chair

unless suspension ropes and sling are of steel. In such cases, the sling shall be of at least $\frac{3}{8}$ -inch diameter wire rope.

10304 FLOAT (SHIP) SCAFFOLDS

1. **Purpose.** Scaffolds of this type shall be used only for the support of men doing riveting or other light work.

2. **Open Flame Nearby.** Burning and welding, the use of a blowtorch, or the presence of any open flame shall not be permitted on or nearby float scaffolds unless suspension ropes are of steel. The use of fiber rope under these conditions is prohibited.

3. **Number of Men.** A maximum of two men shall be permitted to work on a scaffold.

4. Dimensions

1. The plank bearers shall be not less than 2 inches by 8 inches and should project not less than 6 inches beyond the platform on both sides. A diagonal plank, not less than 1 inch by 6 inches, shall extend from bearer to bearer underneath the platform. Each platform plank shall be nailed to this diagonal board and to the two parallel plank bearers.

2. The holes in the bearer planks, as specified above, should be approximately 2 inches outside the outer planks.

3. Platforms shall not be more than 5 feet wide and 8 feet long.

4. Ends of platform planks shall extend at least 6 inches but not more than 12 inches beyond the outer edges of the bearers.

5. **Rope Size.** Rope shall be not smaller than $\frac{7}{8}$ inch in diameter.

6. **Support of Platform.** The platform shall be supported by a continuous rope at each end. The ends of each rope shall be securely fastened to an adequate overhead support.

7. **To Prevent Slipping.** The platform shall be so secured to the rope that slipping is impossible. A bowline knot should be used. Rope should pass downward through a 1-inch hole in the bearer plank, be angle-hitched around the bearer plank and pass along beneath it to the other end, where it should be angle-hitched and passed upward through the 1-inch hole to the overhead support.

10305 INTERIOR-HUNG SCAFFOLDS

1. **Substantial Beams.** Where an interior-hung scaffold is required for ceiling work, it shall be hung or suspended from substantial beams of the roof structure.

2. **Dimension of Materials.** For interior-hung scaffolds, the following minimum nominal size material shall be used:

Bearers.....	2 x 10 in. (12 ft. on center)
Joists.....	3 x 4 in. (24 ft. on center)
Wire cable.....	$\frac{1}{2}$ in. diameter
Spacing of cables.....	10 ft. to 12 ft.

3. **Work Load.** Irrespective of the above schedule, all interior-hung scaffolds shall be designed to sustain a uniformly distributed work load of at least 15 pounds per square foot. When used for plastering, this scaffold shall be designed to sustain a distributed working load of at least 25 pounds per square foot. A factor of safety of four shall be applied in both cases.

4. **Cables Securely Fastened.** The interior-hung scaffold shall be supported by means of wire cables, which shall be wrapped twice around the supporting member and twice around the bearer of the scaffold.

5. **Cable Clips.** Each end of the cables shall be secured by at least three standard cable clips.

10306 MASONS' SWINGING SCAFFOLDS

1. **Design of Scaffold.** Swinging scaffolds intended for masons' use in setting stone or cleaning down walls, shall be similar in design to other swinging scaffolds, but shall have a platform at least 30 inches wide suspended from overhead steel beam outriggers with steel wire cables and operated by a scaffold machine.

2. **Use of Two Scaffolds.** When two or more such scaffolds are in use on a building, they shall not be bridged across one to the other or lashed together.

3. **Platform Construction.** The platform shall be not more than 20 feet in length and constructed with 4-inch channel at each end. Channel shall be laid flat with flanges down and slotted to receive the machine hangers.

4. **Stringers.** The two side stringers should be bolted to the channels.

5. Tie Rod. There shall be a $\frac{5}{16}$ -inch diameter tie rod located 7 feet from each end of the platform, passing through the side stringers and drawn up tight with washers, nuts, and lock nuts.

6. Guardrail. A standard guardrail shall be secured to angle iron uprights, bolted to the stringers.

7. Uprights. The uprights shall be located at each end of the platform with two in between, equally spaced. The space between the guardrail and platform shall be provided with a side screen.

10307 NEEDLE-BEAM SCAFFOLDS (See 10504)

1. When Used. Needle-beam scaffolds shall be used only for the support of men doing riveting and other light work.

2. Dimensions of Wood. Needle-beams not more than 12 feet in length between supports shall be not less than 4 inches by 6 inches in size. The greater dimension shall be vertical and should be increased in size when longer or when required for the load they are to support.

3. Intermediate Supports. Long needle beams shall be provided with intermediate supports or hangers.

4. Splicing Prohibited. Needle-beam scaffolds shall always be in one length. Spliced or built-up beams shall never be used.

5. Secured Against Displacement. Needle-beam scaffolds shall be secured against displacement. When one end is supported on the building structure, the overlap for support shall be not less than 6 inches.

6. Used for Rivet Heaters. When needle-beam scaffolds are used for rivet heaters, the platforms shall be the full permissible width of 6 feet and not less than 10 feet long, with planks laid close together and all edges provided with standard toeboards.

7. Specifications for Steel. Steel or wrought iron used for needle-beam scaffolds shall be free from rust or scale. When the scaffold span is not more than 12 feet, pipe beams should be at least $3\frac{1}{2}$ inches in diameter. When more than 12 feet and not more than 16 feet, the diameter should be 4 inches. The diameter should be correspondingly increased with an increase in the span.

8. Rope

a. SIZE. Fiber rope 1 inch in diameter and greater shall be used.

b. METHOD OF ATTACHING. The ropes shall be attached to the needle beam by a scaffold hitch or a properly made eye-splice looped over the standing part of the rope. The loose ends of the ropes shall be tied to the rope by a bowline knot or a round turn and two half hitches.

c. ARRANGING HITCH. The scaffold hitch shall be so arranged that the needle beam will be prevented from rolling or turning.

d. SPACE FROM END OF BEAM. The rope shall be attached to the beam at a point not less than 1 foot from the end with provision being made to prevent its slipping over the end of the beam.

9. Platforms

a. DIMENSIONS. Platforms shall be not more than 6 feet wide. When the platform is suspended inside a building it shall be not less than 2 feet 6 inches wide, and when suspended outside a building it shall be not less than 3 feet wide.

b. THICKNESS. When the span between needle beams is 12 feet or less, the platform planks shall be 2 inches thick by at least 10 inches wide and increased in thickness as the span increases.

c. LENGTH OF PLANKS. Platform planks shall be at least 2 feet longer than the span between needle beams.

10. Beams not of Equal Height. When needle-beam scaffolds are used where one beam is higher than the other, the planks shall be secured against slipping. A hole should be bored through each end of every plank, with a bolt slipped through the hole and provided with a tightly fitting nut. The bolt should be steel not less than $\frac{5}{8}$ inch in diameter and not less than 8 inches long. The plank shall be laid with the bolts outside the supporting beams.

11. Platform Cleats. When platform planks are used in steeply inclined positions they shall be provided with cleats to prevent slipping thereon. Cleats shall be at least $1\frac{1}{2}$ inch by 2 inches, spaced not more than 8 inches apart and securely nailed to the plank.

12. Burning and Welding. Burning and welding, the use of blow torch or any open flame shall not be permitted on or near needle-beam

scaffolds unless suspension ropes are of steel. The use of fiber rope under these conditions is prohibited.

13. Chafing Pads. Chafing gear (pads) shall be placed on all sharp corners of beams where ropes or slings of steel or manila are used to suspend scaffolds.

10308 OUTRIGGER SCAFFOLDS (SUSPENDED SCAFFOLDS)

1. Construction. Scaffolds shall be supported by thrustouts securely attached to the frame of the building. Each thrustout shall be equal in strength to a 6-inch I-beam at 12.25 pounds per foot or a 3 by 10 heavy timber set on edge, and shall not extend more than 6 feet from the building. The inner ends, extending into the building, shall be supported, braced, anchored, and securely fastened in place. (See 10508 for illustration.)

2. Guardrail. Heavy outrigger scaffolds shall be provided with standard guardrails supported on uprights and securely fastened to the thrustouts. These uprights shall be long enough to drop 12 inches below the outrigger and the lower end securely braced to it.

3. Toeboard. Standard toeboards and side screens shall be provided.

4. Horse Scaffolds Prohibited. Horse scaffolds shall not be erected upon the platform of an outrigger scaffold.

5. Wall as Support. Outriggers shall not be built into the wall and left with no other support.

6. Bracing. The projecting ends of outriggers shall be supported by external braces and struts when extra support is required. These shall not be depended upon as the main support.

7. Spacing. Thrustouts shall be spaced not to exceed 6 feet on centers.

8. Buckling. The thrustouts shall be rigidly held to prevent turning or buckling.

9. Construction of Platform. The platform shall be constructed of planks 2 by 10 inches securely nailed to the thrustouts and laid close together, except for a 1-inch space along the wall of the building.

10. Projection of Planks. The ends of all planks shall rest on the back of the thrustouts and shall project not more than 12 inches beyond.

11. Suspended Platforms. When working platforms are suspended from the thrustouts, they shall be supported by vertical hangers of not less than 2 by 6 inches and shall not be more than 10 feet long. They shall be securely nailed to the side of the thrustouts and extend at least 10 inches above the top of the thrustouts and to a block resting on the top edge of the thrustouts.

a. BEAMS. The suspended platform shall be supported on 2- by 6-inch beams, nailed to the vertical hangers and rest on a block that shall be spiked to the side of the hangers below the beam.

b. PLANKS. The suspended platform shall be formed of 2- by 10-inch planks, nailed close together across the back of the bearer and provided with a standard guardrail, toeboard, and side screen protection.

Section 4

MISCELLANEOUS TYPES

Horse Scaffolds, 10401
 Plasterers' Scaffolds, 10402
 Carpenters' Bracket Scaffolds, 10403
 Crawling Boards or Chicken Ladders, 10404

Ladder Jacks, 10405
 Roofing Brackets, 10406
 Window Jack Scaffolds, 10407

10401 HORSE SCAFFOLDS (See 10505)

1. **Rigid Construction.** "Horses" used for scaffold purposes shall be rigid and of solid construction.

2 Dimensions

a. **OVER-ALL SIZE.** A well-designed horse should have: a spread between the foot of the legs of about 24 inches, a taper in towards the top, a height of about 48 inches. The top horizontal members should be about 48 inches long.

b. **MATERIALS.** The following nominal size materials for a well-constructed horse 4 feet long are recommended:

Bearers.....	3 in. x 4 in.
Legs.....	2 in. x 4 in.
Longitudinal brace between legs.....	1 in. x 6 in.
Gusset brace at top of legs.....	1 in. x 8 in.
Half diagonal braces.....	1 in. x 4 in.

c. **BRACING.** If the horse is longer or higher than 4 feet, the cross section of the members should be increased and the horse rigidly braced.

3. **Extending Legs Prohibited.** The nailing of extension pieces on the legs of horses to increase the height is prohibited.

4. **Using Shim Pieces.** If horses are not the same height, shim pieces shall be used on back of the horses so that all planks will get a solid bearing.

5. **Spacing.** Horses shall not be spaced more than 4 feet apart for heavy-duty scaffolds nor more than 7 feet 6 inches for a light-duty scaffold.

6. **Height of Scaffold.** Horse scaffolds shall not be erected more than three tiers of horses nor more than 16 feet high.

7. **Placing in Tiers.** In erecting successive tiers of horses each horse shall be placed directly over the horse in the tier below.

8. **Building up with Bricks or Tile.** If a slight increase in the height of a platform is desired, low tiers of brick or tile may be built up on the top scaffold plank to support the raised platform. This elevation shall be not more than 12 inches. Where this is done, the platform plank should be cleated from below.

9. Foundation of Horses

a. **STRONG FLOORING.** Horses shall not stand directly on the back of beams or joists but shall stand on a strong temporary flooring of planks.

b. **LEVEL AREA.** All horse scaffolds shall be set on a solid and level foundation, with the legs standing on sections of 2-inch planking and not directly on the earth.

10. **Nailed to Planks.** On scaffolds more than two tiers high the legs of the horses shall be nailed down to the planks to prevent displacement. The tiers of horses shall be braced together.

11. **Support of Planks.** Platform planks shall be supported on at least three horses, one at each end and one in the center. Under any circumstance, horses shall be close enough to eliminate spreading and excessive springing of the planks.

12. **Laying of Planks.** Planks shall be laid so that there is no danger from tipping.

13. **Use of Ladders.** When ladders are placed against horse scaffolds they shall be located near the horses, the planks against which they rest being firmly nailed down. The horses that support the planks shall also be nailed to the plank upon which they stand.

14. Squares Used as Horses

a. **HINGES.** "Squares" hinged together to be used as horses shall be provided with a tie across the bottom to prevent spreading to a distance more than two-fifths the height of the square.

b. **SPAN.** The distance between squares used as horses shall not exceed 12 feet.

15. **Toeboards.** When it is necessary for the protection of workmen below, a standard toeboard shall be provided on the outer edge and ends of the scaffold.

16. **Guardrails.** Where horse scaffolds are erected three tiers high, standard guardrails shall be provided on the top tier.

10402 PLASTERERS' SCAFFOLDS

1. **When Used.** Lathers', plasterers', and decorators' inside scaffolds shall be constructed in accordance with the requirements for pole scaffolds, chapter 10, section 2. They shall be erected when work is to be done which cannot be reached safely from planks supported on ladders.

2. **Constructed With Trestle Ladders.** When a light-duty portable scaffold is formed of planks supported or hitched on trestle ladders, the base of the ladder shall be secured against opening up to the full spread before laying on the planks.

10403 CARPENTERS' BRACKET SCAFFOLDS (See 10509)

1. **When Used.** When bracket scaffolds are used at heights exceeding 12 feet, standard guardrails shall be installed.

2. **Dimensions.** The brackets shall be built of material of not less than 2 by 3 inches, mortised together and bolted.

3. **Supporting Bolt.** The supporting bolt shall be not less than $\frac{5}{8}$ of an inch in diameter. It should be welded to a flat iron member, not less than 2 feet long, which shall be spiked and set in flush with the top surface of the horizontal member. Length of bolt shall be sufficient to extend well inside the studs (when secured to a frame building) and shall be provided with washer and lever-handled nut.

4. **Length of Bolt.** There shall be at least 2 inches of threaded bolt beyond the nut when screwed up.

5. **Inspection.** The supporting bolt and nut shall be frequently inspected, and renewed when the threads show signs of wear.

6. **Construction.** In erecting a bracket, a 2 by 6 inch block shall be laid horizontally across

the inside of two studs, with the bolt passing through the block and screwed up tight.

7. **Strength.** The brackets shall be of sufficient strength to carry a load of 400 pounds on the extreme outer ends.

8. **Spacing.** Brackets shall be spaced not more than 12 feet apart.

9. **Platform.** The platform shall be two planks wide, the plank ends overlapping the bracket not less than 6 inches nor more than 12 inches.

10404 CRAWLING BOARDS OR CHICKEN LADDERS

1. **Single or Double.** Where crawling boards (or chicken ladders) are used on roof work, they may be either single or double.

2. **Catch Platform or Lifeline.** When crawling boards are used on a roof where the pitch is more than 3 inches in 1 foot, a catch platform or lifeline shall be provided.

3. **Dimensions.** A single crawling board shall be at least 10 inches wide and not less than 1 inch thick. Cleats as long as the width of the board, and at least $1\frac{1}{2}$ inches wide by 1 inch thick, shall be nailed to the board.

4. **Upper End Secured.** The board shall be laid on the roof so that its length extends from the ridgepole down to the eaves. The upper end shall be securely engaged to the ridge with hooks or fastened with a cleat.

5. **Double Boards.** Where double boards are used, each section shall be made similar to the single board. The two sections should be hinged or bolted together. They shall be laid so the hinge bolt will rest on the peak or ridge pole.

10405 LADDER JACKS (See 10509)

1. Specifications

a. **TYPES.** Ladder jacks shall be of an approved type.

b. **LADDERS.** Ladders used with ladder jacks should be designed and constructed in accordance with requirements in article 07111.

2. Limitation of Use

a. **HEIGHT.** Ladder jacks shall not be used at a greater height than 22 feet above the ground or working level.

b. **NUMBER OF PERSONS.** Only one person shall be allowed to work on a ladder-jack scaffold at any one time.

c. NOT TO BE USED WITH EXTENSION LADDERS. Ladder jacks shall not be used on extension ladders.

3. Safety Feet. Ladders used with ladder jacks shall be placed and secured to prevent slipping. In addition, ladders should be equipped with safety feet.

4. Platforms

a. OVERLAP. Platform planks should overlap the bearing surface at least 4 inches but not more than 8 inches.

b. SPAN. Platform planks shall not have a greater span than 10 feet unless provided with a center support.

c. CLAMPING. The ladder jack shall be clamped or otherwise securely fastened to the platform and shall bear on the side rails.

10406 ROOFING BRACKETS

1. Construction. Roofing brackets shall be triangular in shape, formed of three pieces of 2- by 4-inch material. The diagonal member should be sloped to fit the pitch of the roof and the horizontal member leveled to support the plank.

2. Supports. Roof brackets shall be securely supported by means of ropes fastened at one end to a hook securely hooked over the ridge pole and, at the other end, to a 5/8-inch eye bolt securely screwed into the roofing bracket; or by means of pointed projectors driven their full length in the frame or woodwork of the roof. The ropes may also be secured to chimney or roof members or other solid objects on the other side of the roof.

3. Catch Platform. When work is done on roofs which are more than 20 feet from the ground to the eaves, and when there is no parapet wall at the eaves, and such roof has a slope greater than 3 inches in 1 foot, a substantial catch platform should be provided. Catch platforms should be of sufficient width to extend at least 2 feet beyond the outer edge of the eaves' projection. In addition, the platform should be equipped with a standard guardrail.

4. Lifeline. As an alternative to such a platform, each man working on the roof should be provided with a lifeline securely fastened to a fixed anchorage.

10407 WINDOW JACK SCAFFOLDS (See 10509)

1. When Used. Window jack scaffolds shall be used only for the purpose of working at the window opening, through which the jack is placed.

2. Only One Person Permitted. One person only is permitted on the scaffold at any one time.

3. Working Load. Window jacks shall be constructed to sustain a working load of at least 200 pounds with a factor of safety of four.

4. Anchoring to Structure. Window jacks shall be securely anchored to the structure.

5. Use of Window Jacks. Window jacks shall not be used as the supporting element of scaffolds.

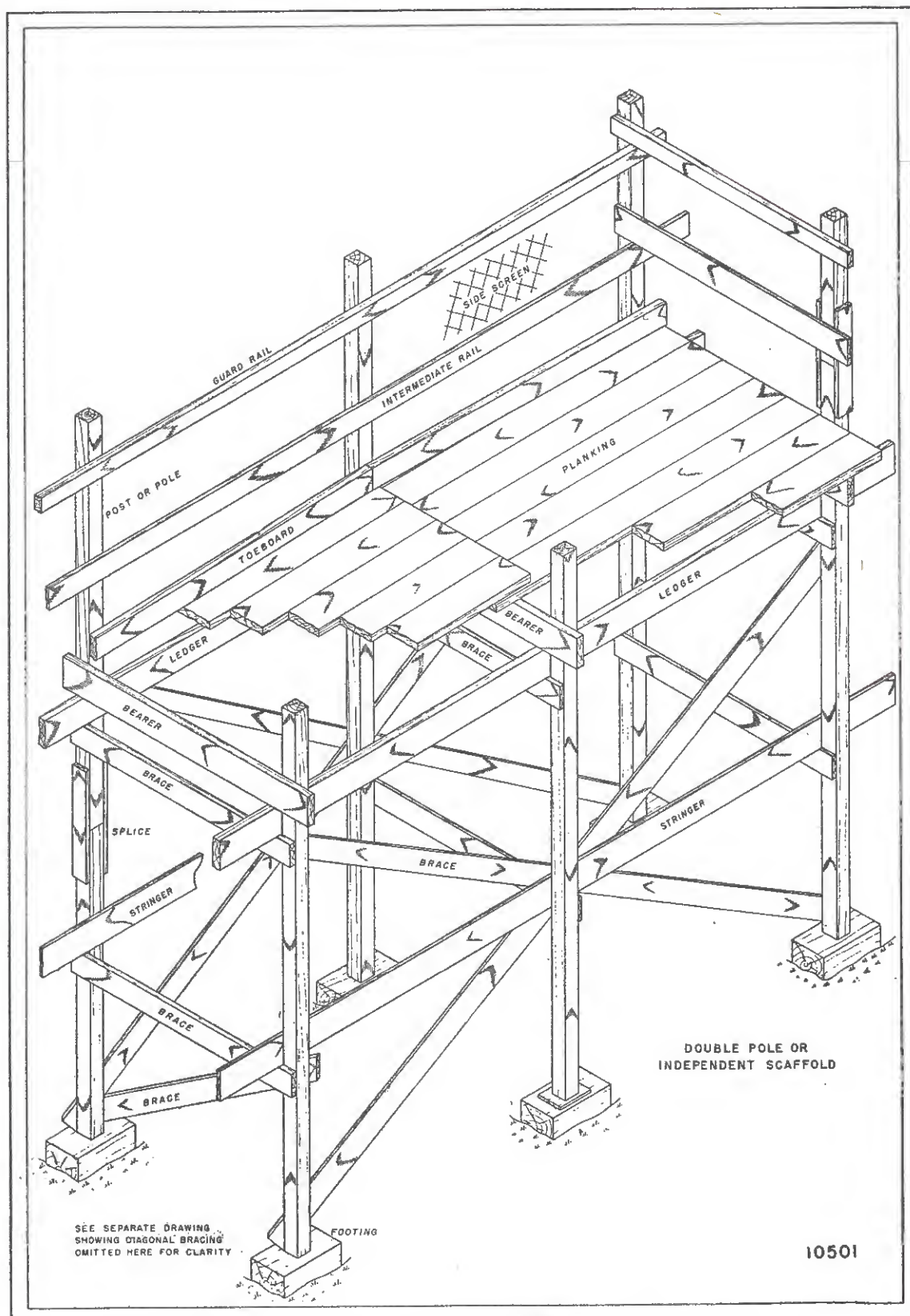
6. Planks Between Window Jacks. The placing of planks between window jacks is prohibited.

Section 5

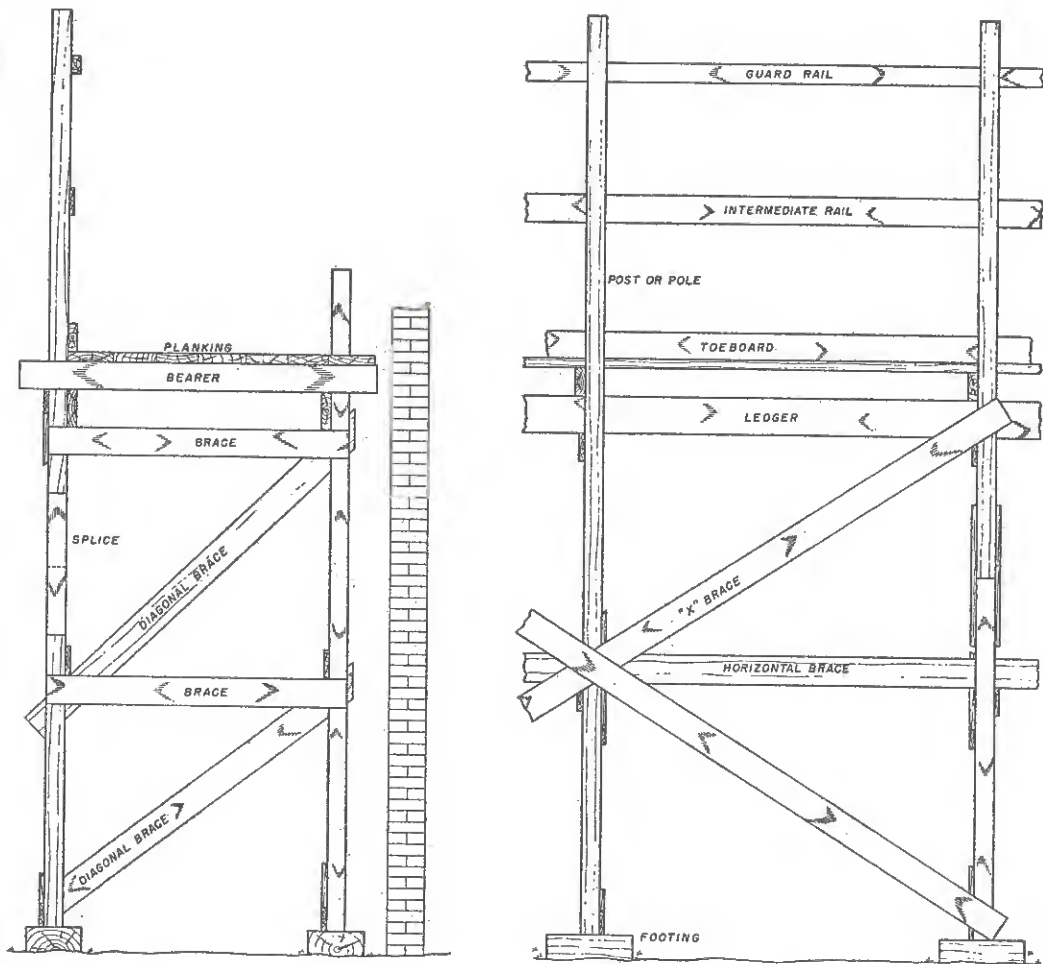
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The following illustrations appear through the courtesy of the Chief of Engineers, United States Army.



10501

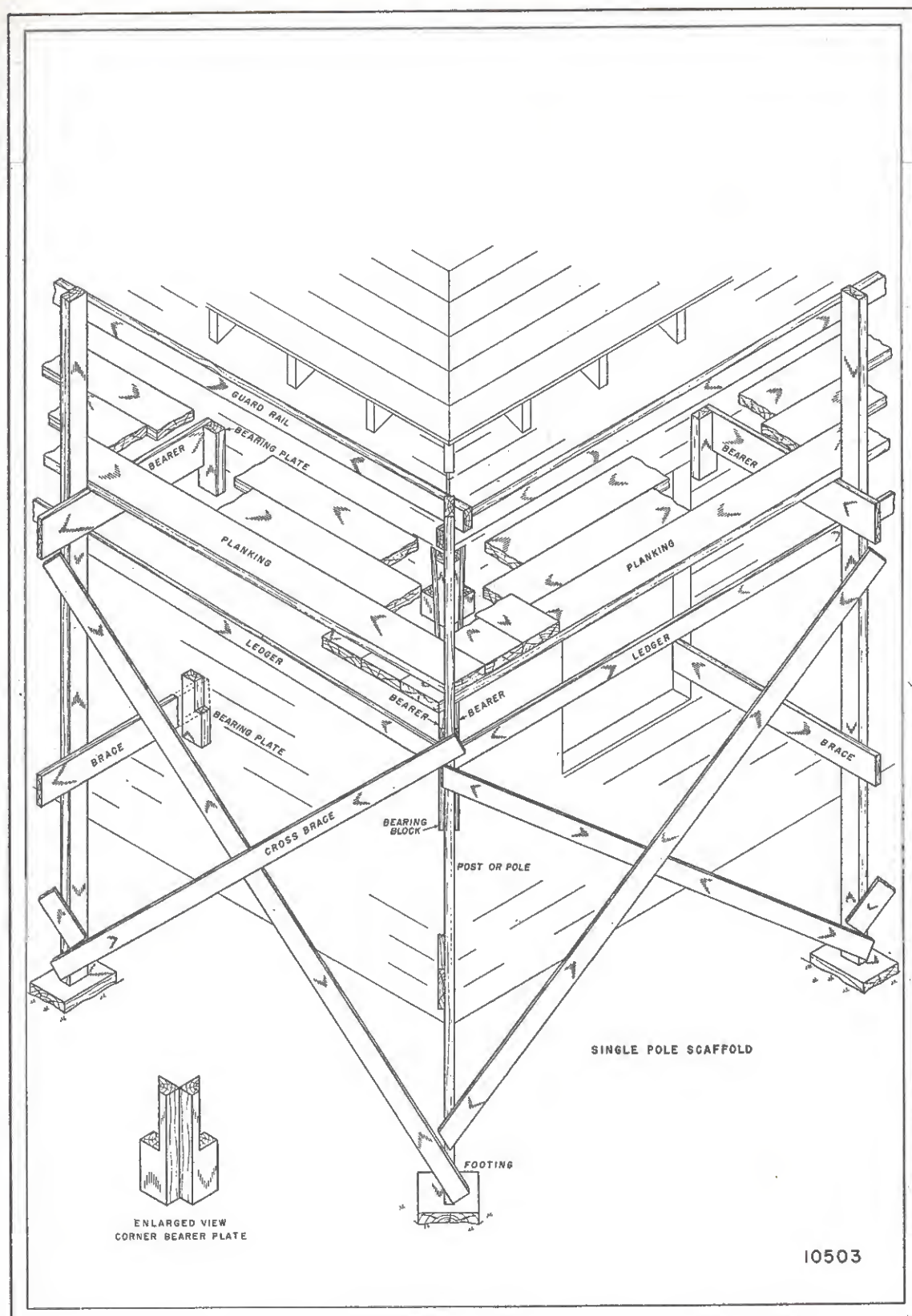


END VIEW

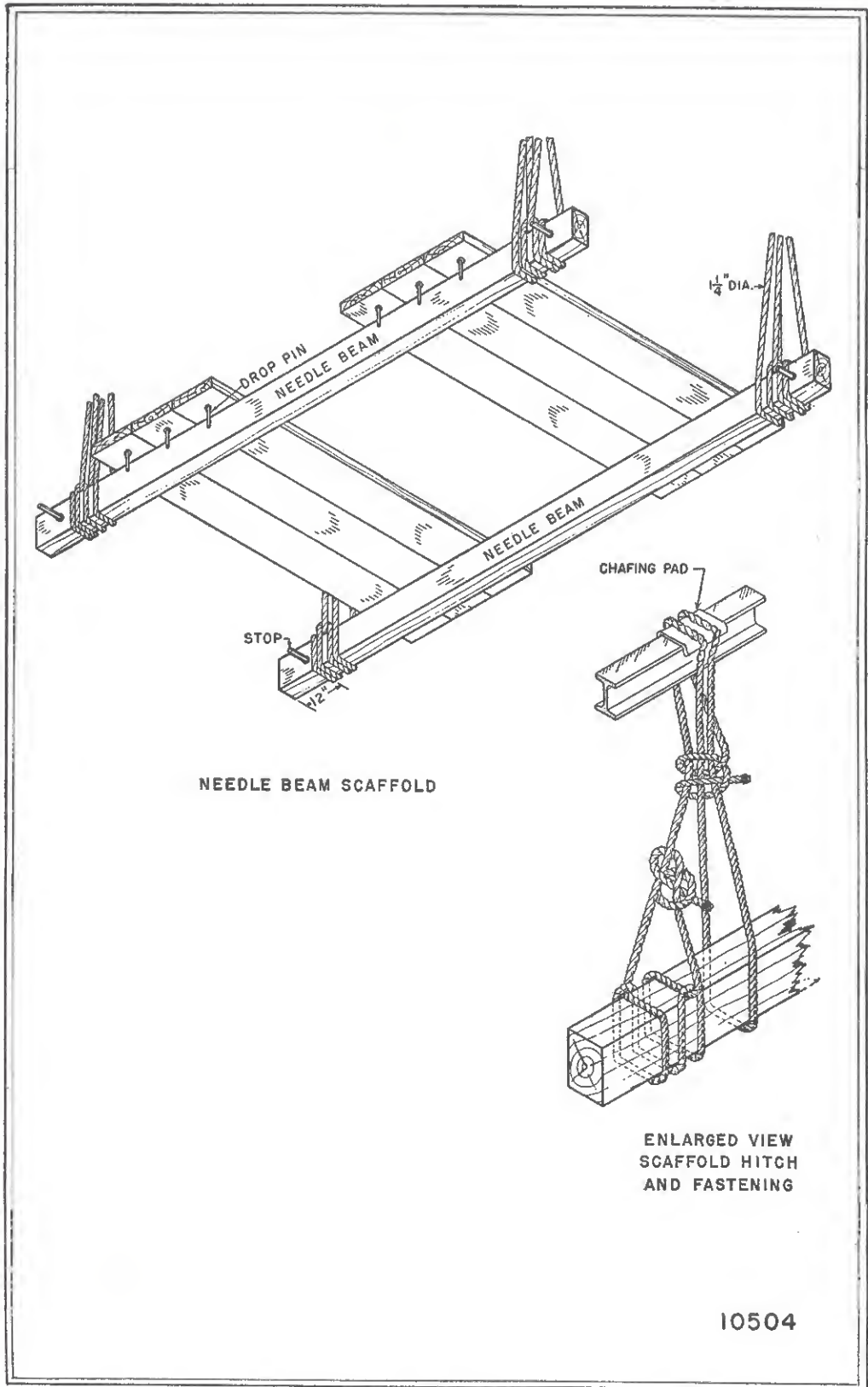
DOUBLE POLE OR
INDEPENDENT SCAFFOLD

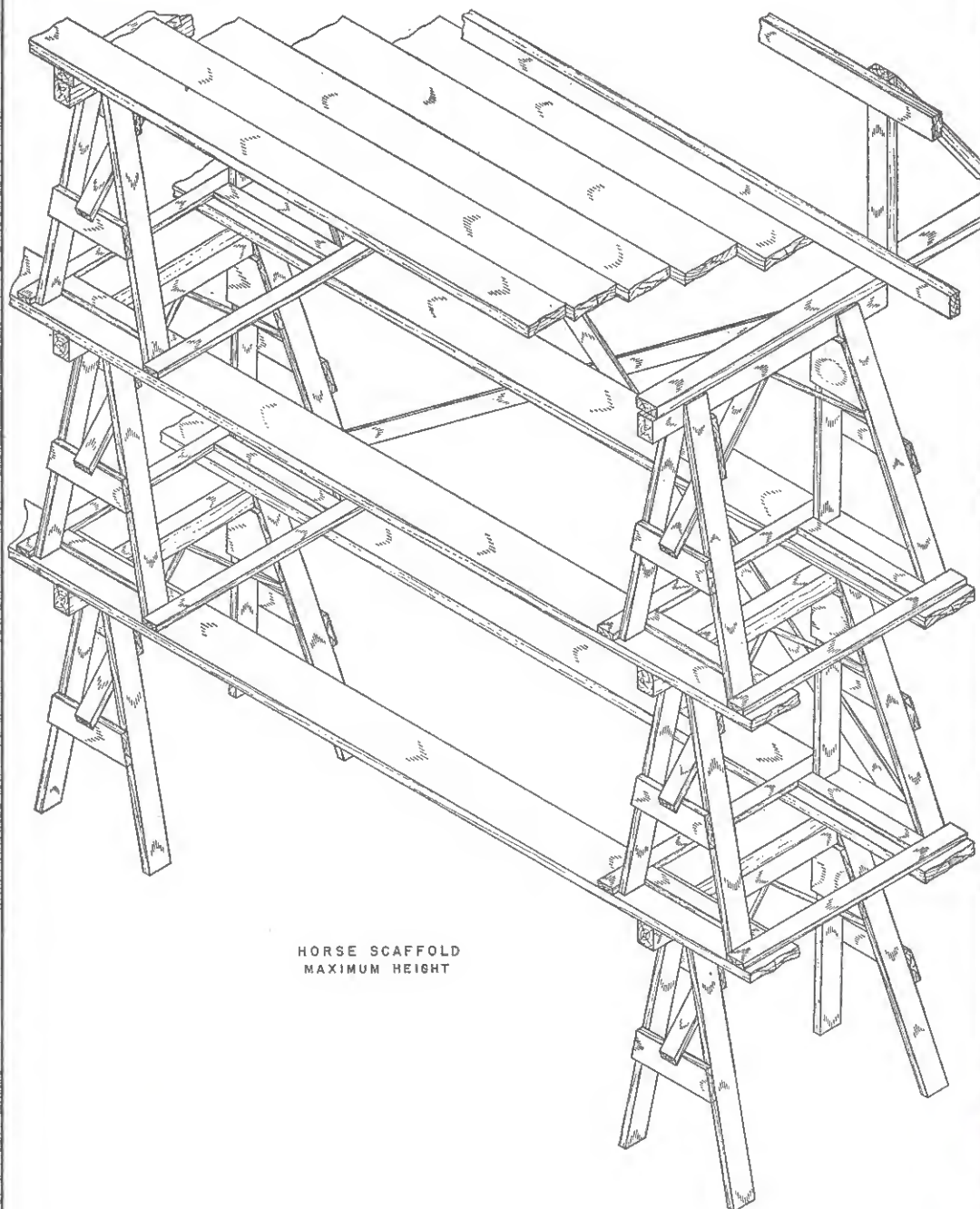
BACK VIEW

10502

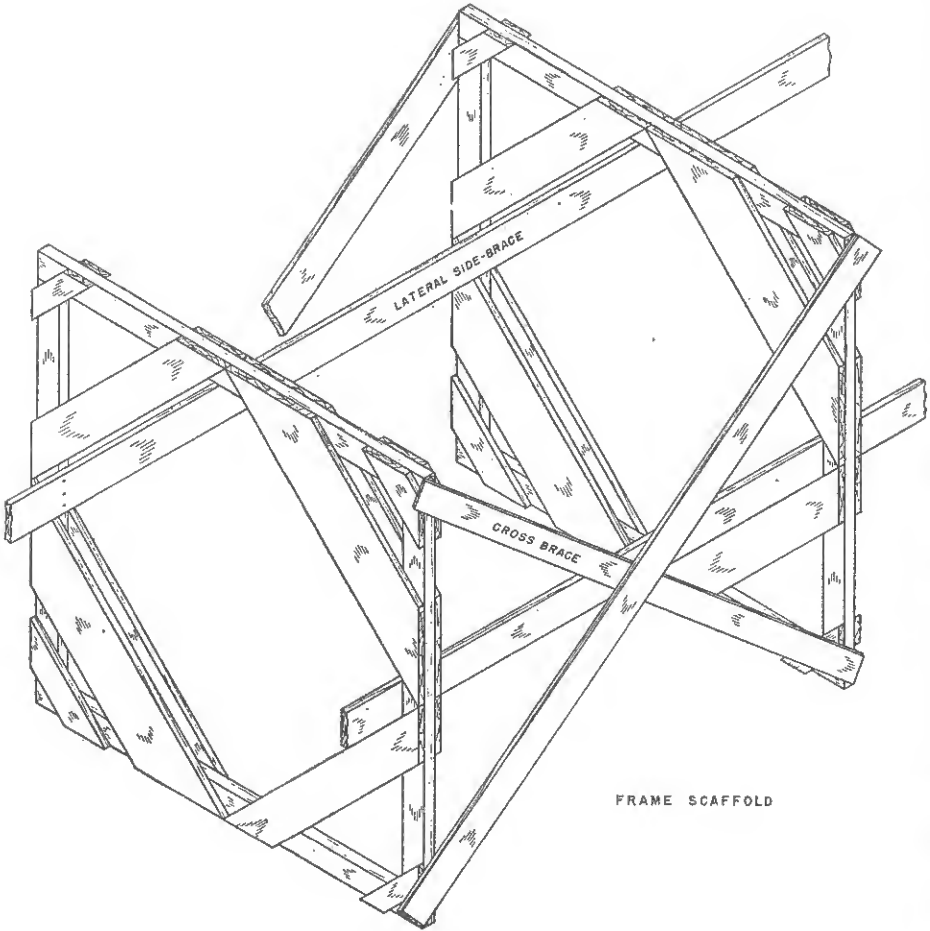


10503



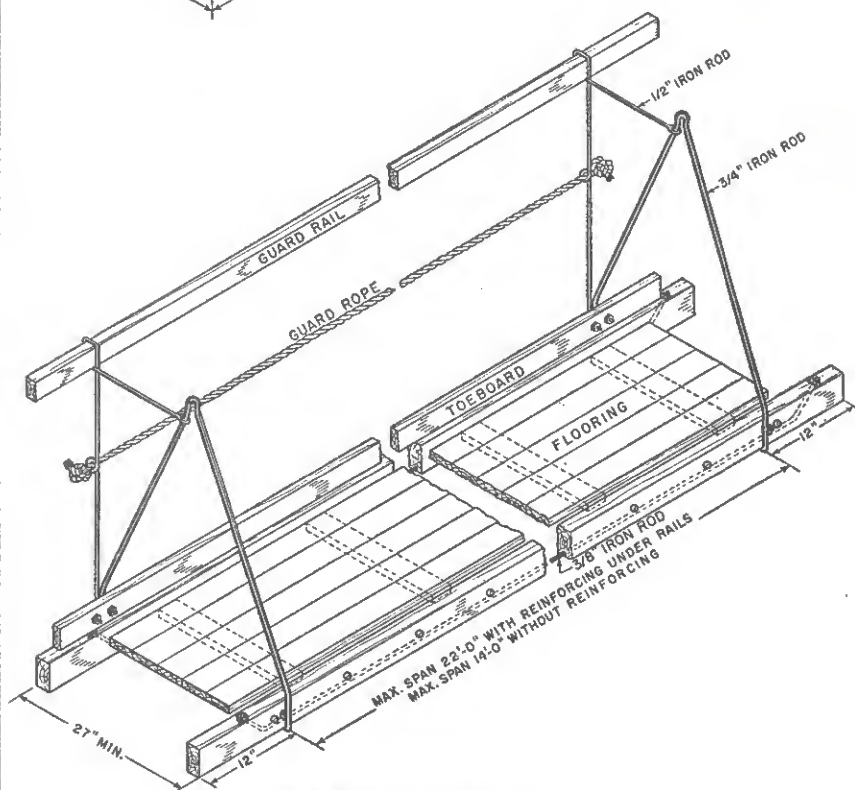
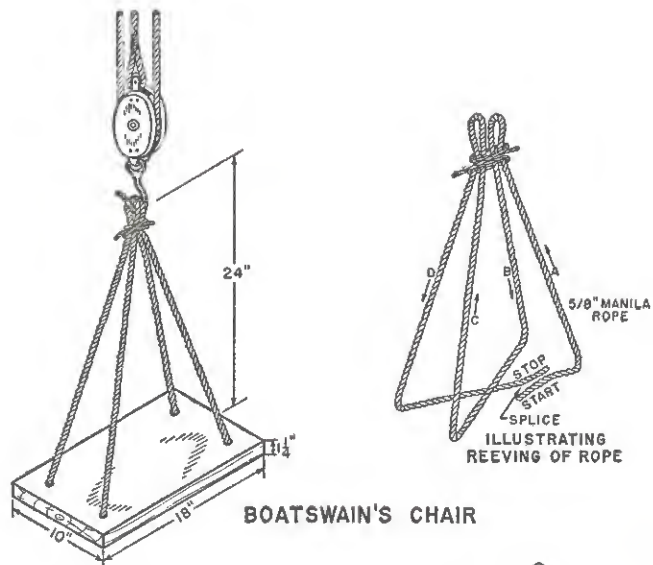


10505

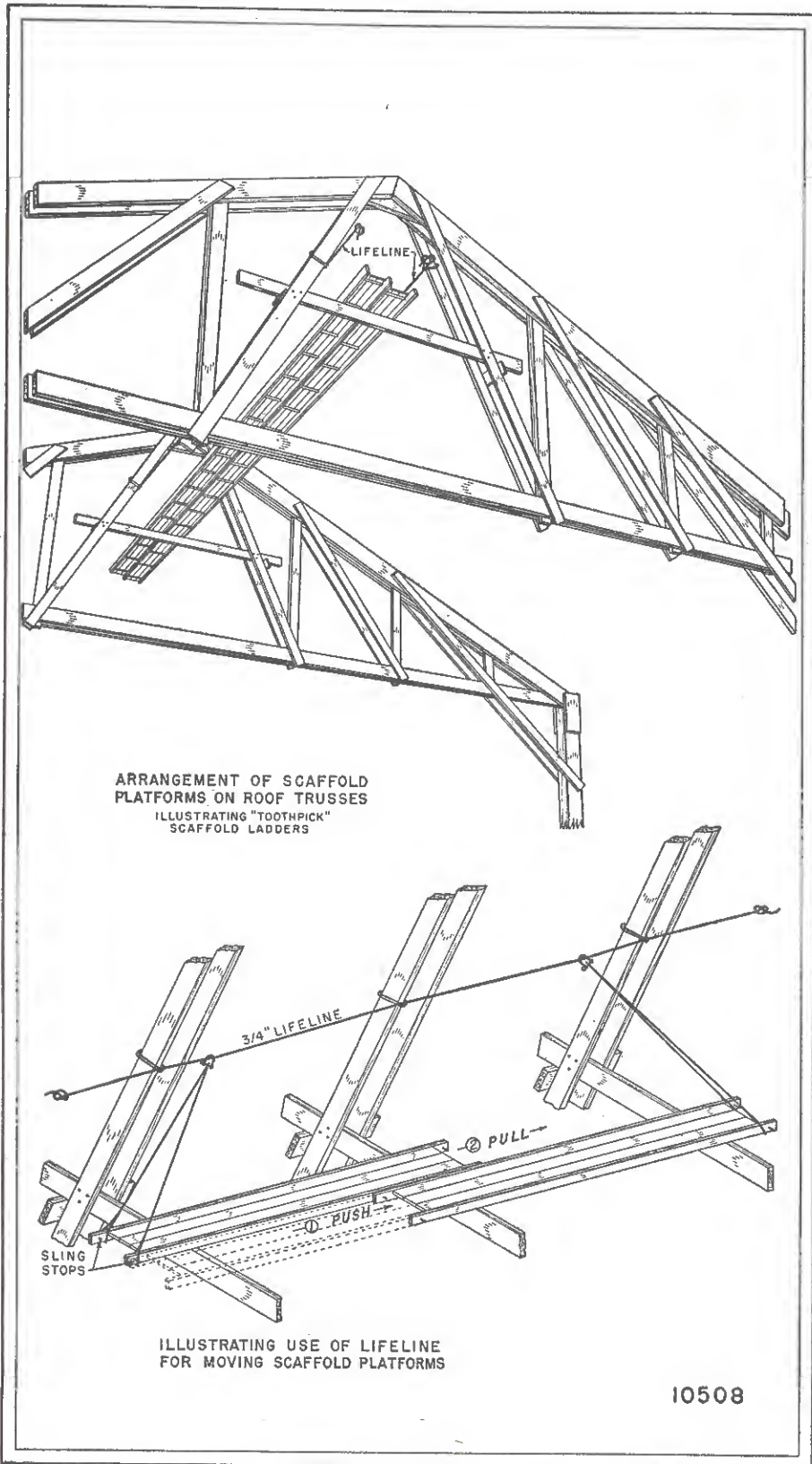


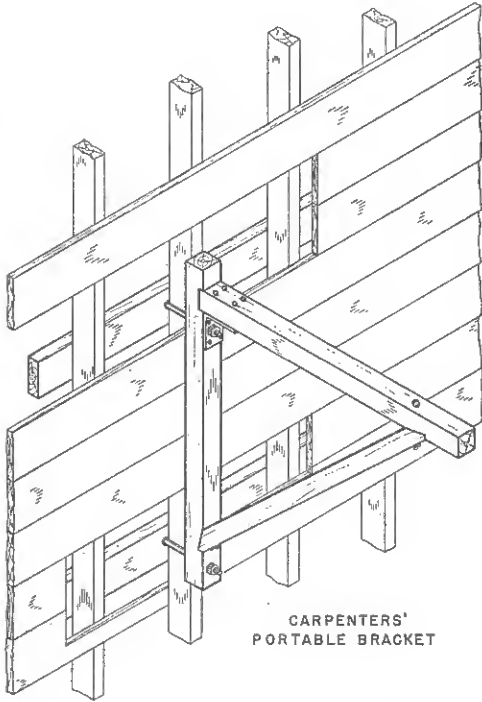
FRAME SCAFFOLD

10506

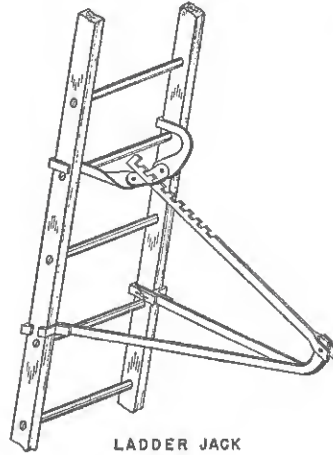


10507

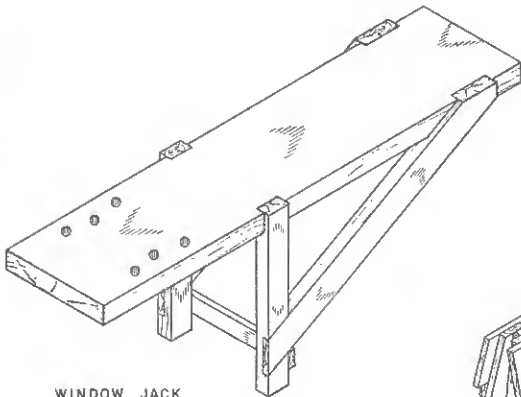




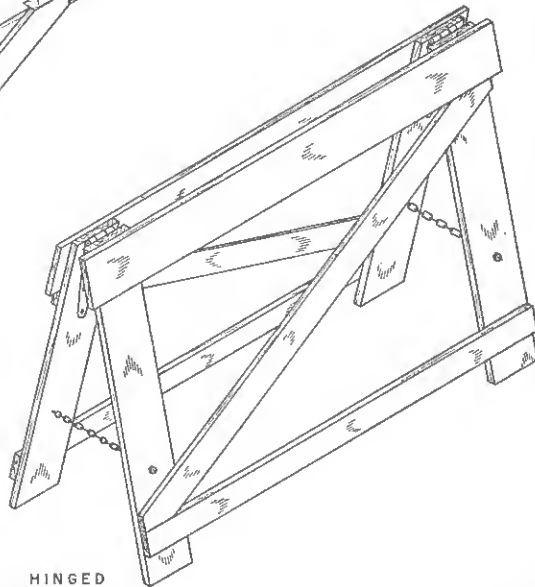
CARPENTERS'
PORTABLE BRACKET



LADDER JACK

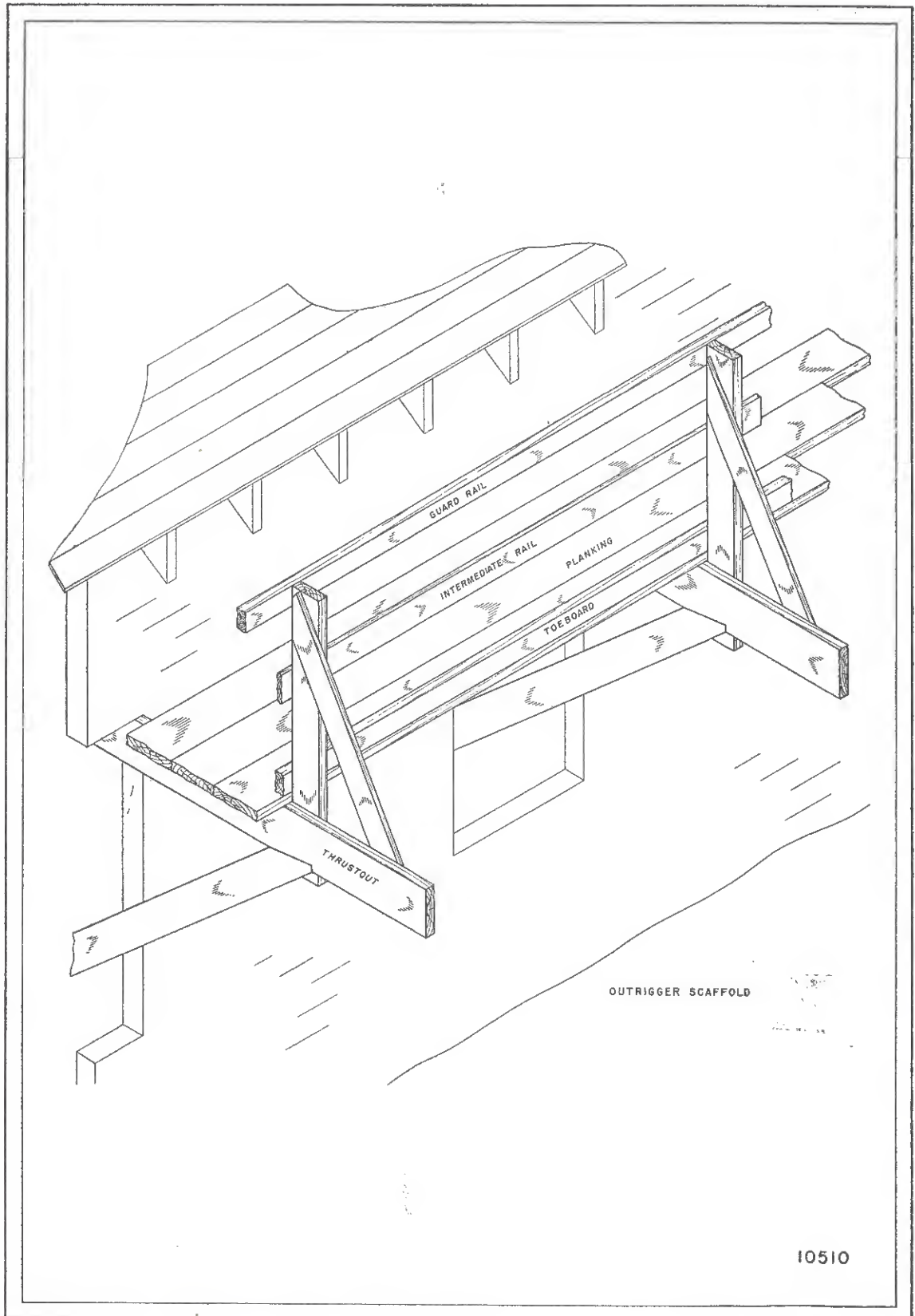


WINDOW JACK



HINGED
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10509



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United States Navy
SAFETY PRECAUTIONS

Chapter II
WELDING AND CUTTING

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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11101 SCOPE

This section of this chapter shall be used as the safety code for naval establishments and on shipboard in the operation of equipment used in welding, cutting, and allied processes. For processes not specifically covered herein, the American Standards Association "Safety in Electric and Gas Welding and Cutting Operations" Z-49.1, 1950 or later, shall be used as a supplementary safety code for naval personnel.

11102 TERMS USED

1. **Approved or Approval.** When referring to appliances or equipment, these terms mean tested by a naval test laboratory and found suitable for installation and use in naval establishments or aboard naval vessels.

2. **Welder, Welding Operator, or Operator.** As used herein these terms are intended to designate any operator of electric or gas welding and cutting equipment (including operators of the equipment when used for heating operations).

3. **Hot Work.** Hot work is work involving welding, flame cutting, the use of open-flame equipment, or any work involving heating metal to or above a red heat. Riveting and any cold work involving the probability of striking sparks shall be considered as hot

work, except when, in the opinion of the supervisor in charge, circumstances do not necessitate such a classification.

11103 LOCATION

1. **Where Performed.** The convenience of arc and gas welding and cutting lies largely in the fact that the equipment can be taken to the job and the work done in place. This very convenience, however, makes possible construction and repair jobs in confined or remote locations that have not been laid out in the expectation that so much or such concentrated heat, or mixtures of noxious or explosive gases, would be introduced into that space. Therefore the preparations described in the following paragraphs are essential.

2. **Preparation of Location.** Welding and cutting operations should be conducted in locations that have been specifically designated for the purpose. Other locations may be used if they have been freed of fire hazards by removal or protection of combustible or explosive materials, liquids, or vapors, and if suitable precautions have been taken against the re-accumulation of such materials. When welding or cutting is to be done in any location other than one specifically designated for such purposes, approval of the job and of precautions to be taken shall be obtained from the officer in charge before operations are started.

3. Welding Aloft. If it is necessary for a welding operator to work on platforms, scaffolds, or runways at an elevation of more than 5 feet, provision shall be made to prevent falling. This can be accomplished by the use of railings, safety belts, lifelines, or other safeguards as specified elsewhere herein.

4. Prohibited Areas. Welding or cutting operations shall not be performed in or on the outer surfaces of rooms, compartments, or tanks; nor in areas adjacent to rooms, compartments, or tanks; nor on or in closed drums, tanks, or other containers, which hold or have held flammable or explosive materials, liquids, or vapors, unless and until all fire and explosion hazards have been eliminated according to the applicable procedures specified in 11321-11333.

5. Fire Watch. When flammable or explosive materials will be exposed to welding or cutting operations, a fire watch shall be posted in that vicinity. Fire watchers shall be posted on both sides of a deck, bulkhead, wall, or ceiling being worked on if fire hazards exist on both sides. The fire watch shall remain at their stations for a reasonable time (at least 30 minutes) after the job is completed to ensure that there are no smoldering fires.

11104 DANGERS

1. Fire and Explosion. Personnel performing welding, cutting, or heating operations (hot work) in small spaces must take the recommended precautions against the ever-present hazard of suffocation or fire and explosion.

2. Lethal Vapors. Welding operators must guard against breathing the noxious and sometimes lethal gases which may be formed under certain conditions. Inadequate ventilation while welding may cause illnesses such as metal fume fever or metal poisoning.

3. Electric Shock. In electric arc welding, even low voltages may be a potential source of serious shock when certain unfavorable conditions exist. (See chapter 18.)

4. Eye Injury. Eye injuries from the brilliant light of the arc or from heavy gas welding may be very serious.

5. Body Burns. Body burns from the arc or from molten metal are a constant danger as

well as burns from handling hot objects such as wires, tools, rod, etc.

6. Combination of Circumstances. Moreover, personnel should exercise judgment and attempt to prevent other hazards which might be created by a peculiar combination of circumstances not specifically mentioned.

11105 WELDING APPARATUS

1. Approved Apparatus. Use only approved apparatus, such as torches, regulators, hose, valves, electric welding machines and accessories, or specialized apparatus that have been examined and tested and found to be safeguarded insofar as is practicable. Helmets, hand shields, goggles, and clothing shall be approved types made of a material which is an insulator for heat and electricity, is not flammable, and is capable of withstanding sterilization.

2. Instruction of Operators. Workmen designated to operate welding or cutting equipment shall have been properly instructed and qualified to operate such equipment.

It is important that electric welding equipment be installed only by competent and experienced personnel in accordance with approved plans. This requirement is especially applicable to the installation of specialized equipment such as acetylene generators, flame hardening outfits, etc., and of primary power lines and outlets intended to supply electric welding machines. All precautions outlined by the manufacturer shall be followed in addition to all procedures set forth in this chapter under gas welding, arc welding, protection of personnel, ventilation of confined spaces, and hot work in way of flammable or explosive materials, and entry into closed compartments.

3. Inspection of Apparatus in Confined Spaces. While equipment is in use, especially while operating in confined spaces, it shall be frequently inspected for evidence of leaks in the hose, couplings, valve stems, or other points of the system. If leaks are not promptly detected, an explosive or lethal mixture of gas and air may accumulate with serious results.

4. Blocking Portable Equipment. Before operations are started, heavy portable equipment

mounted on wheels shall be securely blocked to prevent accidental movement.

5. Suspending of Work. When work in a confined space (except in shop spaces authorized for active stowage of welding equipment) is to be suspended for any substantial period of time, such as during lunch or overnight, the following special precautions must be taken.

a. ARC-WELDING EQUIPMENT

1. All electrodes shall be removed from the holders.
2. All arc welding equipment shall be disconnected from the source of power.
3. All such equipment, including the electrode holder, shall be positively insulated so that no accidental contacts can be made even if the equipment is moved during this period.

b. GAS WELDING EQUIPMENT

(1) *Gas Supply to Torch.* In order to eliminate the possibility of gas escaping through leaks or improperly closed valves during gas welding or cutting, the torch valves shall be closed and the gas supply to the torch positively shut off at some point outside the confined area.

(2) *Removal of Torch.* Where practical, the torch and hose shall also be removed from the gas supply during such time. For securing equipment when not in use see 11208-7.

6. Protection of Equipment. Welding equipment used in the open should be protected from inclement weather. When not in use, the equipment should be stored in a clean, dry place.

11106 FIRE-EXTINGUISHING EQUIPMENT

1. Use of CO₂ Water Lines, and Water Pump Tanks. Suitable fire-extinguishing equipment of approved types shall be maintained near all welding and cutting operations. The suitability of the equipment shall be judged by an analysis of the conditions at the scene of operations. If, for instance, the only combustible material within range of the welding or cutting operations or sparks therefrom is bitumastic waterproofing, a CO₂ extinguisher may be adequate. However, in a small space with a very small access opening, the operator may not be able to get out quickly in case of fire and the use of CO₂ might be injurious to him. Under such conditions the use of water from a 1½-inch water line or water pump tank would be preferable.

2. Combatting Electrical Fires. Again, if the insulation of some electrical equipment that cannot be removed or adequately protected is the only combustible material present, then a water spray may be more perilous than the fire itself. For combatting electrical fires CO₂ should be provided.

3. Carbon Tetrachloride. Carbon-tetrachloride extinguishers shall *not* be used. "Carbon-tet" on hot metal decomposes to form phosgene, a very deadly gas, and may be more dangerous than the fire itself if used inside a closed compartment.

4. Care of Equipment. All installed fire-fighting equipment including sprinkler systems located within the compartment where work is to be conducted, and in adjacent compartments, shall be maintained in working order at all times when welding or cutting operations are in progress.

Subsection B

PERSONNEL PROTECTION

11121 PROTECTIVE CLOTHING

1. Clothing Required. The officer in charge or safety engineer shall determine the appropriate protective clothing required for any welding operation, depending upon the size, nature, and location of the work.

2. Gloves. Welding operators should at all times wear flameproof gauntlet gloves complying with applicable specifications.

3. Protection from Radiated Heat and Sparks. Flameproof aprons, jackets, sleeves, or leggings made of leather, asbestos, or other suitable ma-

terial should be worn as protection against radiated heat and sparks, particularly during overhead welding. Coveralls, etc., shall not have steel buttons, steel belt buckles, etc., which may scrape on metal and strike a spark.

4. Alternate Clothing. If leather clothing is unavailable, woolen clothing is preferable to cotton because it is not so readily ignited and helps protect the operator from changes in temperature. Cotton clothing, if used, should be chemically treated to reduce its flammability. All outer clothing such as jumpers or overalls should be reasonably free from oil or grease. Oilskins shall not be worn by any operator while using welding or cutting equipment.

5. Plastic Clothing. Certain waterproof plastic clothing appears to store up large amounts of static electricity after very light friction and should not be worn by members of cleaning parties or others working around tanks likely to contain explosive vapors.

6. Rolled Up Sleeves and Pockets. Sparks may lodge in rolled up sleeves or pockets of clothing or cuffs of overalls or trousers. Sleeves and collars shall be kept buttoned and pockets not protected with flaps shall be eliminated from the front of overalls and aprons. Trousers shall not be turned up on the outside.

7. Protection of Legs and Feet. For very heavy work, fire resistant leggings, high boots, or other equivalent means should be used. The use of low-cut shoes with unprotected tops is not recommended. Safety shoes or boots should be worn which do not have exposed nail heads or rivets.

8. Head Protectors. Where there is exposure to sharp or heavy falling objects, hard hats should be used. Leather skull caps may be worn under helmets to prevent head burns.

11122 EYE PROTECTION

1. Goggles. Not only welding and cutting operators, but also other personnel such as helpers, chippers, inspectors, etc., who must remain in the vicinity, shall use suitable helmets, handshields, or goggles during all welding operations, in order to protect their eyes from stray flashes, reflected glare, and flying particles. All lenses in goggles and helmets shall meet the tests for transmission of radiant energy pre-

scribed in the applicable naval department specifications and shall have the shade of lens specified under paragraph 6 below.

2. Types of Goggles. There are two general types of goggles.

a. SPECTACLE. Spectacle type goggles are made both with and without metal side shields. They may have either a rigid nonadjustable or adjustable metallic bridge.

b. EYECUP OR COVER. Eyecup or cover type goggles have flexibly connected lens containers shaped to conform to the configuration of the face. The cover type is designed to be worn over correcting spectacles whereas eyecup goggles are worn alone.

3. Overhead Welding. Only the eyecup or cover type goggles should be used when welding or cutting near or above eye level.

4. Goggles for Gas Welding. Spectacle type (side shielded) or eyecup or cover type goggles shall be used during all gas welding or cutting operations. Spectacle type goggles without side shields and with suitable filter lenses are permitted for use with gas-welding operations on light work and for inspection.

5. Protection for Electric Arc Welding. Helmets or hand shields shall be used during all arc welding or cutting operations. Spectacle type (side shielded) goggles should also be worn on these operations to provide protection from injurious rays from adjacent work and from flying objects. The goggles may have either clear glass or colored glass. When colored glass is provided in the goggles, the shade numbers for the glasses in the goggles and the helmet shall be determined as indicated in the following paragraph.

6. Shade of Lens. The lens to use in any instance may well be determined by the individual operator who is wearing or using the helmet, hand shield, or goggles, but should not vary more than two shades from those recommended in the following tables. The object is not only to diminish the intensity of the visible light to a point where there will be no glare, so that the welding area can be distinctly seen, but also to protect the welder from the harmful infrared and ultraviolet radiations from the arc or flame.

The following list should be used for guidance in selecting goggles:

<i>Shade of Lens</i>	<i>Kind of Work</i>
Clear glass in spectacle type (side shielded) or up to shade 4 in any type	Light electric spot welding or for protection from stray light from nearby welding
No. 5 filter	Light gas cutting and welding
No. 6 filter	Gas cutting, medium gas welding, and arc welding up to 30 amperes
No. 8 filter	Heavy gas welding and arc cutting and welding, 30-75 amperes
No. 10 filter	Arc cutting and welding 76-200 amperes
No. 12 filter	Arc cutting and welding 201-400 amperes
No. 14 filter	Arc cutting and welding exceeding 400 amperes

7. Transferring Equipment. Helmets and goggles should not be transferred from one person to another without antiseptic cleaning.

8. Welding Bays Painted Black. Where welding with the electric arc is regularly carried on, the walls of the welding bay shall be painted flat black or other nonreflecting color to prevent flickering reflections or the work should be enclosed in a booth.

9. Portable Booths. Where the work permits, workers or other persons adjacent to the welding areas shall be protected from the rays by means of enclosing the work area with flame-proof screens or individual booths which have been painted with a nonreflecting color, such as zinc oxide and lamp black.

10. Treatment of Arc Burned Eyes. In case of temporary eye burns the eye will not be permanently injured, but the pain may be intense for as long as 24 to 48 hours. Obtain medical treatment promptly if arc burn is felt or suspected.

11123 RESPIRATORS AND AIR-LINE MASKS

1. Lead and Cadmium Paints and Alloys. When an operator is engaged in welding or cutting

lead-bearing steels, lead or cadmium-bearing paint or low melting point lead alloys, whether indoors or out, an air-line mask or local exhaust ventilation at the point of origin shall be used. Where conditions do not permit their use, a filter-type respirator, approved for protection from lead fumes, may be used but only where the work is carried on intermittently and for short periods.

2. Welding Inside Closed Containers. Where welding operations are carried on inside tanks or other closed containers, air-line respirators or hose masks should be furnished the men so employed; and when used, a workman shall be stationed on the outside to service the power and ventilation lines to insure the safety of those working within. The attendant should observe the welding operator at all times, and in case of emergency shall immediately shut off the gas or electric current and render such other help as the occasion warrants. A filter type respirator may be used for short periods of time.

11124 SAFETY BELTS AND LIFELINES

Where a welding operator must enter a confined space through a manhole or other small opening, means shall be provided for quickly removing him in case of emergency. Safety belts and lifelines used for this purpose shall be so attached to the operator's body that the body cannot be jammed in a small exit opening.

11125 COMMUNICATION

When men are in tanks and other such spaces, even after such spaces have been cleaned and found "SAFE", a reliable man shall stand outside at the manhole and keep count of the men in the space and communicate with them every few minutes to be sure that no one has been overcome by lethal gases.

11126 WARNING ABOUT HOT METAL

After welding operations are completed, the welder shall mark the hot metal or provide some other means of warning other workers.

Section 2

OPERATING PRECAUTIONS

Subsection A Gas (Oxyacetylene) Welding

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Subsection A

GAS (OXYACETYLENE) WELDING

11201 CYLINDERS, GENERAL

General directions for the safe handling and stowage of compressed fuel gas and oxygen cylinders are given in chapter 17, (Fuels and Compressed Gases). Following are a few special precautions concerning cylinders when in actual use in welding or cutting, or in "active stowage" (ready service).

1. Specifications for Cylinders. All portable cylinders that are used for the storage or shipment of compressed fuel gases or oxygen shall have been furnished in accordance with the applicable naval specifications, and such regulations as are prescribed by the Interstate Commerce Commission. Cylinders shall be marked in accordance with the requirements set forth in chapter 23, of the BuShips Manual, as well as in accordance with the applicable requirements of the above specifications and I.C.C. regulations.

2. Markings. No one shall alter or tamper with numbers or markings stamped into or painted on cylinders except at Bureau of Ships authorized activities.

3. Call by Proper Names

a. FUEL GASES. Fuel gases should be called acetylene, hydrogen, etc., and not by the word "gas", which is a general term including oxygen, etc.

b. OXYGEN. Oxygen should be called by its proper name—not, for example, by the word "air".

4. Refilling Cylinders. Refilling of cylinders and transfer of gas from one cylinder to another within the naval establishment shall be done *only* by competent personnel at naval activities authorized by the Bureau of Ships to do so, and shall be done according to approved procedures.

5. Mixing Fuel Gases and Air or Oxygen. Mixtures of combustible gases and air are very

explosive and shall be carefully guarded against. No device or attachment facilitating or permitting mixture of air or oxygen with combustible gases prior to consumption, except at the burner or in a standard torch or blow pipe, shall be allowed unless approved for the purpose.

6. Mixing Gases. No one shall mix or attempt to mix different fuel gases in one cylinder nor mix any fuel gas with oxygen in one cylinder.

7. Use for Other Purposes. No one shall use a container for any purpose other than that for which it was intended.

8. Safety Devices. No one shall tamper with safety devices in cylinders or valves.

9. Assigned Locations. Keep all cylinders in definitely assigned locations that are:

1. well ventilated and away from corrosive chemicals and fumes;
2. away from radiator or other source of heat or fire; in summer, away from direct rays of the sun;
3. away from elevators, stairs, or gangways;
4. free from danger of being knocked over or damaged by heavy objects passing or falling;
5. where they cannot form part of an electric circuit;
6. away from combustible material, especially grease and oil;
7. far enough away from the actual welding or cutting operations so that sparks, hot slag, or flame will not reach them;
8. on or above the weather deck.

10. Securely Fastened. Cylinders in use or in stores or cargo shall be securely fastened to prevent shifting or falling under any weather conditions.

11. Confined Spaces. When welding or cutting is being performed in any confined space with difficult means of exit, the gas cylinders and heavy welding or cutting equipment shall be left on the outside.

12. Protection from Ice. Cylinders in the open should have valves and safety devices protected against accumulations of ice and snow. Warm (not hot) water shall be used to thaw ice in cylinder valve outlets.

13. Excessive Heat. In summer, cylinders in the open shall be screened from the direct rays

of the sun to protect against excessive temperature rises. (The maximum temperature to which cylinders should be subjected is 130° F. Higher temperatures may cause dangerous pressure increases.)

11202 HANDLING OF CYLINDERS

1. Use of Cradles, Racks, Platforms. When loading or transferring cylinders, especially when using a crane or derrick, the cylinders shall be secured in a cradle, boat, suitable platform, rack, or special container (such as a sand bag). Cargo nets, rope, or chain slings should not, and electromagnets must not be used for this purpose. Valve protecting caps shall be in place during such operations.

2. Do Not Drag or Slide Cylinders. Cylinders moved by hand should be tilted and rolled on their bottom edges without dragging or sliding. Cylinders shall not be dropped or struck, and they shall not be permitted to strike each other violently.

3. Do Not Use as Roller or Support. Cylinders shall not be used as rollers or supports, especially for welding or cutting operations, even if they are thought to be empty.

4. Remove Regulators Before Moving. Unless cylinders are secured in a special rack, regulators shall be removed and valve-protection caps should be put in place before cylinders are removed.

5. Rough Handling. All cylinders shall be handled carefully. Rough handling, knocks, or falls are likely to damage the cylinder, valve, or safety devices and cause leakage. Dropping or careless handling can break off a cylinder valve, and a sudden release of oxygen from a full cylinder can cause it to take off like a rocket.

6. Use of Hand Truck. Wheeled hand trucks for transporting and holding cylinders while welding or cutting are not recommended for shipboard use unless the commanding officer considers that their use will expedite operations. If used, the truck shall be of substantial design as follows:

a. STRAPS NECESSARY. The cylinders shall be individually secured to the truck with metal strap clamps (rope or chain is not considered adequate).

b. FASTENED TO BULKHEAD. The truck shall be

securely and firmly fastened to a bulkhead or stanchion to prevent shifting or falling under any weather conditions.

c. RIGID FRAME. The frame shall be rigid enough to permit handling with tackle.

d. HANDLES. Grips on handles shall end in a line vertical with the aft side of the wheels to facilitate fastening to a bulkhead.

e. SIDES. Platforms shall be fitted with sides to prevent cylinders from sliding off.

11203 CYLINDER VALVES

1. Protection Cap. Valve protection caps are designed to protect valves from damage. Before raising cylinders from a horizontal to a vertical position, the cap should be properly in place, the cap should be turned clockwise to see that it is hand-tight, then the cylinder should be raised by grasping the cap. Hooks or line through valve protection caps shall not be used for lifting cylinders from one vertical position to another. Crowbars shall not bear on valves or valve-protection caps when prying loose cylinders that are frozen to the deck or otherwise fixed. Valve-protection caps should always be in place except when cylinders are in use or connected for use.

2. Open Valves Slowly. Cylinder valves shall always be opened slowly.

3. Never Repair Valves. Never tamper with nor attempt to repair cylinder valves. If trouble is experienced, indicate on a "defective" tag the nature of the trouble and return the cylinder to the supplier.

4. Do Not Force Valves. Do not use a hammer or a wrench to open cylinder valves. If valves cannot be opened by hand, tag them as defective and in need of repairs before recharging.

5. When the Oxygen Cylinder Is in Use. The valve should be opened at least one full turn, preferably all the way, to prevent leakage around the valve stem. Avoid complete removal of stem from a diaphragm type valve (it might be lost or dirt might enter the mechanism).

6. Closing Valves. Valves shall be closed under the following conditions:

1. before moving cylinders;
2. when work is finished;
3. when cylinders are "empty".

11204 FUEL-GAS CYLINDERS

1. Vertical Position. Acetylene and liquefied fuel-gas cylinders shall be placed with valve-end up whenever they are used. They should also be stowed in this position and not allowed to lie on their sides. If horizontal stowage is necessary, cylinders must be in vertical position 48 hours before using. Otherwise acetone in which the acetylene is dissolved will be drawn out with the gas.

2. Leaking Cylinders. If a leak develops at a fuse plug or elsewhere on a cylinder, it shall be removed to the weather well away from any source of ignition, the cylinder valve slightly opened, and the fuel gas allowed to escape slowly. A warning shall be placed near this cylinder not to approach it with a lighted cigarette or other source of ignition. Such a cylinder shall be plainly tagged as defective and in need of repair before refilling.

3. Leaking Around Valve Stem. If, when the valve on a fuel gas cylinder is opened, there is found to be a leak around the valve stem, the valve should be closed and the gland nut tightened. If this does not stop the leak, the use of the cylinder should be discontinued. The cylinder shall be plainly tagged as defective and in need of repairs before using or recharging. If the need to use the cylinder is very urgent, the leak can probably be stopped by opening the valve all the way; but this should be done only when emergency conditions requiring quick closing of the cylinder valve are not likely to occur.

4. Leaks in Piping. Tests for leaks of any piping system or apparatus shall be made with soapy water. Use grease-free soap. NEVER EMPLOY FLAMES TO DETECT LEAKS.

5. Opening of Valve. An acetylene cylinder valve opened $\frac{1}{4}$ to $\frac{1}{2}$ turn will permit an adequate flow of gas; and in order that the valve may be turned off quickly in case of emergency, it should not be opened more than one and one half turns.

6. Keeping Wrench Available. Where a special wrench is required it shall be left in position on the stem of the valve while the cylinder is in use so that the fuel gas can be quickly turned off in case of emergency. In the case of manifolded or coupled cylinders, at least one such

wrench shall always be available for immediate use.

7. Protection of Safety Plug. When cylinders are in use, nothing shall be placed on top of an acetylene cylinder which may damage the safety plug or interfere with the quick closing of the valve.

8. Pressure of Acetylene. Under no conditions shall acetylene be generated or used at a pressure in excess of 15 pounds p.s.i. gage pressure. This requirement is not intended to apply to the storage of acetylene dissolved in a suitable solvent (such as acetone) in cylinders manufactured according to Interstate Commerce Commission requirements and to applicable naval specifications.

9. Liquid Acetylene. The use of liquid acetylene in welding is prohibited.

11205 OXYGEN CYLINDERS

1. Keep Away from Oil and Grease. Keep oxygen cylinders and fittings away from oil and grease, which in the presence of oxygen under pressure, may burst into flame. A jet of oxygen shall never be permitted to strike an oily surface or greasy clothes, or to enter a fuel oil tank or other compartment that has contained a flammable substance. Every possible precaution shall be taken to prevent oily and greasy substances from coming in contact with cylinders and cylinder valves. Do not handle oxygen cylinders, valves, regulators, hose (oil or grease deteriorates rubber), and other apparatus or fittings with oily hands, gloves, or greasy materials. Cylinders shall never be stowed or used where oil or grease from ship's machinery or overhead cranes or belts can splash or fall upon them. Oxygen will not burn, but it supports and accelerates combustion and will cause oil and other flammable materials to burn more easily and with greater intensity.

2. Keep Away from Combustibles. Do not store oxygen cylinders near highly combustible material, especially oil and grease; or near reserve stocks of acetylene or other fuel gas cylinders; or near any other substance likely to cause or accelerate fire.

3. Not a Substitute for Compressed Air. A serious accident may easily result if oxygen is

used as a substitute for compressed air. Never use oxygen in pneumatic tools, in oil preheating burners, to start internal combustion engines, to blow out pipe lines, to "dust" clothing or work, to create pressure, or for ventilation.

11206 REGULATORS

1. Pressure-Reducing Regulator. Cylinders shall not be used without first attaching an approved pressure-reducing regulator to the cylinder valve or to a manifold.

2. Cracking Cylinder. Before connecting the regulator to the cylinder valve, the valve shall be opened one quarter of a turn and closed immediately. This action is generally termed "cracking" and will clear the valve of dust or dirt that otherwise might enter the regulator. Always stand to one side of the outlet when opening the valve. Never "crack" a fuel gas cylinder near other welding work or near sparks, flame, or other possible sources of ignition. Be sure the regulator is closed (the adjusting screw backed out until loose) before opening the cylinder valve.

3. Connecting Regulator. When a regulator is attached, open the cylinder valve slightly at first so that the regulator cylinder-pressure gage hand moves up slowly; then open the valve all the way. If the pressure is suddenly released, it is likely to damage the regulator and pressure gages.

4. Right- and Left-Handed Threads. Threads on oxygen regulator outlets, hose couplings, and torch valve inlets are right-handed, and acetylene threads are left-handed. Threads on acetylene cylinder valve outlets are right-handed, but of different pitch from oxygen cylinder valve outlets. If threads do not match, the connections are mixed. Do not attempt to force unmatching or crossed threads.

5. Acetylene Valve Outlet. When setting up cylinders for use, the acetylene valve outlet should be pointed away from the oxygen cylinder.

6. Personnel in Front of Pressure Gage. When valves are opened no one should be allowed to stand in front of the pressure gages.

7. Metal Tools. Metal tools (even the so-called sparkless type) for making repairs shall

be used with caution to avoid striking a spark. Such a spark may cause ignition if a mixture of gas and air is present.

8. Modification of Regulators Prohibited. Regulators or automatic pressure-reducing valves shall be used only at the pressures and for the gas for which they are intended. Do not experiment with regulators or modify them in any way.

9. Testing Gages on Regulators. Working or low pressure gages attached to regulators should be periodically tested to ensure their accuracy. Do not test oxygen gages with oil.

10. Faulty Threads or Nuts. Union nuts and connections on regulators should be inspected before use to detect faulty or dirty threads or seats which may cause leakage of gas when the regulators are attached to the cylinder valves. When damaged nuts or connections are found, they shall be removed from service. Dirty threads or seats shall be cleaned.

11. Clear Working Space. Keep a clear space between the cylinders and the work so that the cylinder valves can be reached easily and quickly if necessary.

12. Low Pressure Within Cylinder. The use of any cylinder shall be discontinued before the pressure falls to zero. Oxygen cylinders, particularly, shall not be used in welding or cutting operations, except in an emergency, after the gage pressure falls below approximately 25 p.s.i. Cylinder valves shall then be securely closed and valve protecting caps replaced. These practices prevent moisture, other gases, etc., from contaminating the cylinder before it is refilled. Such cylinders shall be tagged or marked "Empty" or "MT". Empty cylinders shall be segregated from full cylinders, but shall be stowed in the same compartments (or on deck) and otherwise handled with the same precautions as specified for full cylinders.

13. Removal. Before a regulator is removed from a cylinder valve, the cylinder valve shall always be closed and the gas released from the regulator.

11207 PORTABLE MANIFOLDS

When it is necessary to discharge fuel gas or oxygen simultaneously from several cylinders in order to provide sufficient volume for heavy

work on several concurrent jobs, a portable manifold (sometimes called a coupler block) may be used to connect the cylinders to a single regulator or to a single header having several outlets with individual regulators. Portable manifolds shall be of substantial design and capable of safely withstanding any pressure to which they may be subjected in operation.

1. Copper with Acetylene. "Pure" copper, or copper alloys containing 67 to 99 per cent copper, shall NOT be used in piping or fittings for handling acetylene (except blowpipe or torch tips). Acetylene reacts with pure or slightly alloyed copper to form cuprous acetylide, a violent explosive.

2. Flash Arresters. When several fuel gas cylinders are manifolded, approved flash arresters shall be installed between each cylinder and the manifold. For outdoor use only and where the number of cylinders manifolded does not exceed three, one flash arrester installed between manifold and regulator is acceptable.

3. Back-Flow Valve. Each cylinder lead should be provided with a back-flow valve.

4. Capacity. The aggregate capacity of manifolded fuel gas cylinders shall not exceed approximately 2,000 cubic feet of gas.

11208 THE TORCH

1. General. The following precautions, including procedure for lighting, adjusting, and extinguishing torch flames, shall be carefully followed. Closed and poorly ventilated compartments shall be inspected and approved by an authorized person prior to conducting any hot work (*see* 11321). Special precautions indicated by the manufacturer of any apparatus shall also be carefully carried out.

2. Tip or Nozzle Pressure. Always use the proper tip or nozzle, and operate it at the correct pressure for the particular work involved. This information should be taken from tables or work sheets supplied with the equipment.

3. Suitable Source of Ignition. Do not use matches for lighting torches or serious hand burn may result. Use friction (spark) lighters, stationary pilot flames, or some other suitable source of ignition.

4. Lighting Torch. When lighting the torch, open the acetylene valve first and ignite the gas

while the oxygen valve is still closed. Do not allow the unburned acetylene to escape into small or closed compartments.

5. Lighting Torch in Confined Space. Do not attempt to light torches from hot metal, especially in a confined space. An explosive mixture of acetylene and oxygen can accumulate quickly and may cause damage or personal injury if ignited. Do not allow such a mixture to accumulate. Particularly, do not be slow to light a torch, especially a large one for heavy work. A stationary pilot flame, such as a candle, shall be used in lieu of a spark lighter in a confined space.

6. Extinguishing Torch. When extinguishing the torch, close the acetylene valve first, then close the oxygen valve.

7. Securing Equipment When Not in Use. When welding or cutting is stopped and will not be resumed within 15 minutes, or when the operator leaves the scene for any period of time, the equipment shall be secured as follows:

1. Extinguish the torch as in (6) above.
2. Close both acetylene and oxygen cylinder valves. (Leave regulators open momentarily.)
3. Open acetylene valve on torch and allow gas in hose to escape (5-15 seconds) to outside atmosphere, NOT into small or closed compartment. Close valve.
4. Open oxygen valve on torch and allow gas in hose to escape (5-10 seconds). Close valve.
5. Close both regulators. (Note—oxygen and acetylene regulators are closed when adjusting screws are backed out until loose.)

8. Regulators and Valves Clear of Hose. Do not hang a torch with its hose on regulators or cylinder valves. Make certain that the torch is not burning when not in use and that the valves are closed tightly.

9. Valves Tightly Closed. If, after equipment has been in use, it is to be stowed for a considerable period before being used again, it shall be inspected carefully to determine that cylinder and torch valves are firmly closed, regulators are closed (adjusting screws released), and all hose connections are tight. If stowed thus, it is not likely to create any explosion hazards in the

compartment in which stowed, and it can be put back into use at any moment.

10. To Prevent Backfiring. If equipment has been stowed with torch valves open or loosely closed or with hose connections loose, or if hoses and torch are being newly connected prior to use, or if either of the cylinders has just been changed, there is danger of backfiring unless all connections are made tight and the system "purged" of air as follows before the torch is lighted.

11. Purging System of Air. Be sure torch valves are firmly closed; then open cylinder valves slowly. Open regulators slightly. Open torch acetylene valve and allow unlighted gas to escape to the outside atmosphere, not into a small or confined space. Allow gas to flow for 5 to 15 seconds, depending on length of hose, until all air, or mixture of gas and air, has been forced out of the system. Then close the torch acetylene valve. Repeat the procedure on the oxygen side of the system. Then proceed with lighting the torch as above.

12. Uncapped Openings. When combustible gas lines or other parts of equipment are being purged of air or gas, lights or other sources of ignition shall not be permitted near uncapped openings.

11209 HOSE

1. Color. Red is the generally recognized color for acetylene hose, and green or black for oxygen hose.

2. Twin Hose Lines. A single hose with two or more gas passages, in which a wall failure might permit the flow of gas from one passage into the other, or permit the mixing of gases in the hose, is not permitted. Twin hose lines made especially for oxyacetylene operations are permissible when they are substantially two hoses, held together by webbing or other means, and so constructed that gas from one hose line cannot conceivably leak into the other. When parallel lengths of oxygen and acetylene hose are taped together for convenience and to prevent tangling, not more than 4 inches out of each 8 should be covered with tape, otherwise it is difficult to locate leaks and identify hose.

3. Metal Clad Hose. Metal clad or armored hose is not recommended.

4. Worn Spots. Hose shall be frequently inspected for worn spots or defective connections and defective hose shall be repaired or removed from service.

11210 WELDING ON SHIPBOARD

1. Responsibility of Commanding Officer. When oxygen and acetylene or other fuel gases are to be used aboard ship, the cylinders would normally be placed as close as possible to the work. However, in construction, repair, overhaul, or conversion jobs conducted in shipyards, bases, or alongside repair ships, it becomes necessary to decide whether to allow the cylinders and outlet headers inside the ship or to keep them outside. Decision shall rest with the commanding officer and shall be based on an analysis of which set of hazards—that is, leaving equipment inside or taking it outside the ship—can be more readily safeguarded. In either event, before hot work is done in way of flammable or explosive materials and before there is any entry into closed or poorly ventilated spaces, the commanding officer shall see that careful preparations are made as described in 11321 through 11333.

2. Cylinders Inside the Ship

a. FIRE. If cylinders are located inside the ship in many compartments from which they cannot be removed quickly, they may become involved in a fire. There is little danger of the cylinders themselves exploding, but the heat and pressure may open the cylinder safety devices and release the gases. Escaping fuel gases may become ignited and the flaming cylinder will add to the fire; or unburned fuel gas escaping into a confined space may form an explosive mixture before it is ignited; or escaping oxygen may cause a small fire to burn more fiercely.

b. HANDLING CYLINDERS. When cylinders are manhandled through doors and hatches and up and down ladders, special care must be taken to prevent injury to personnel or damage to the cylinders, which in turn may cause an accident. On ships under construction, however, when decks are not in place, rapid and safe handling of cylinders by cranes is practical.

3. Cylinders Outside the Ship. On the other hand, keeping the cylinders, outlet headers, etc.,

outside of ship, on the weather deck, the ways, or the deck, exchanges one set of hazards for another such as:

a. HIGH PRESSURE. Higher gas pressures and additional couplings required for longer hose lines increase the danger of gas leaks into the ship.

b. CUTTING HOSE. Hoses strung out along decks and through doors and hatches are more in danger of being damaged or cut and thus flammable or toxic gases or oxygen-gas mixtures may be released into the ship.

c. SPECIAL PROCEDURES. When men are working deep inside the ship and the cylinders are topside or on the dock, the special procedures relative to stringing hoses through the ship (11211) shall be carefully followed.

11211 STRINGING HOSE THROUGH SHIP

Whenever cylinders, portable outlet headers, or service piping outlets are left in a shop aboard ship, or on the weather deck, the dock, or some other point remote from the scene of work, and hose lines are strung out for long distances to the work, the procedure below shall be followed:

1. Connecting Apparatus. Connect regulators, hose, and torch as outlined in 11206 through 11209.

2. Trial Lighting of Torch. Light torch and adjust regulators for proper pressures. Extinguish torch, leaving supply valves and regulators open temporarily.

3. Inspection for Leaks. Inspect all connections for leaks, especially torch valve and hose connections that will go inside the ship.

4. Close Supply Valves. If no evidence of leaks is found, close the cylinder or other supply valves just behind the regulators. Leave the regulators open at proper adjustments.

5. Protecting Hose. String the hose, with torch attached, to the location of the work. If several hoses are strung through the ship, or if the work will take several hours or days, provision should be made to suspend the hoses off the deck to minimize the danger of damage to the hose. Take all practical precautions to ensure that doors and hatch covers are securely held open to preclude cutting of the hose by

an accidentally closed door or hatch cover, and to guard the hose from damage by traffic in its vicinity.

6. Opening and Closing Supply Valves. An assistant should be assigned to maintain contact with the operator. He should be stationed where he can close the valves quickly in case of an emergency, and reopen the supply valves when directed by the operator. The work may then proceed.

a. SECURING TORCH. If assignment of a helper is not practical, and it is necessary to adjust supply valves, the operator shall *secure the torch* where it is not likely to be disturbed—asking a shipmate or fellow worker to watch it. The operator shall be sure that torch valves are firmly closed before leaving equipment to reopen the supply valves. *He shall return immediately to the torch.*

b. INSPECTION OF HOSE. On each trip the oper-

ator shall follow the hoses and inspect them for damage.

c. RELIGHTED TORCH. If, on his return, the operator detects no odor of acetylene or other indication of danger in the compartment, he may then light the torch and proceed with work.

7. Leaving Equipment Unattended. When leaving equipment unattended for even a relatively short period such as meal time, directions (11208,7) for securing welding equipment shall be carefully followed.

8. Care of Equipment After Using. Upon completion of work, extinguish the torch and direct the helper to *close the supply valves*; or the operator shall *immediately* do it himself. The torch and hose shall *immediately* be removed from the compartment to the outside or stowed with the cylinders in their assigned locations.

Subsection B

ELECTRIC ARC WELDING

11221 PROTECTION FROM SHOCK

1. Working Alone Inadvisable. Whenever it can be avoided, a welding operator should not work alone in a compartment. Immediate care of an operator who has received an electric shock may prevent serious consequences.

2. Care of Equipment. Welding equipment should be maintained in good mechanical and electrical condition to avoid unnecessary hazards. Commutators should be kept clean to prevent excessive flashing.

3. Voltage. All personnel must keep constantly in mind that any electric power circuit, whether AC or DC, high or low voltage, is a potential source of danger. It is important to observe every precaution to prevent shock. Although the voltages required for arc welding are low and normally will not cause injury or severe shock, they are enough to be a potential source of serious shock under unfavorable conditions.

4. Dangers from Low Voltage. One of the prin-

cipal dangers from low voltage welding circuits is the totally unfounded assumption that they can be handled with impunity. The only way to be safe is to handle any electric circuit with extreme caution. The reference to "any electric circuit" is particularly emphasized because the welding operator not only handles the welding circuit, but he also may handle portable lights, portable motor-driven tools, and in many instances he may handle switches or portable cable on the side of the arc welding machine connected to the ship's power system.

5. Keeping Body Insulated. The danger of shock is particularly marked when the operator is sweaty or wet. The operator should develop the habit of always keeping his body insulated from both the work and the metal electrode and holder. It should never be assumed that because contact at one time is not harmful, similar contacts at other times will be similarly harmless. Changes that are not noticeable can take place which could change the effects of contact.

6. Wooden Mats Used for Insulation. Whenever

it is practicable, the operator should stand on dry wooden mats or similar insulating material rather than on grounded metal structure.

11222 ELECTRODE HOLDERS

1. **Safe Capacity.** Only electrode holders which are fully insulated and in good condition shall be used. They shall have been specifically designed for arc welding and of a capacity capable of safely handling the maximum rated current required by the electrodes with which the holder is intended to be used.

2. **Insulation.** Any current-carrying parts passing through the portion of the holder which the operator grips in his hand shall be fully insulated with nonconducting material capable of safely insulating against the maximum voltage encountered to ground. Electrode holders with all metallic or current-carrying parts fully insulated (including the jaws gripping the electrodes) are recognized as affording superior protection to the operator. Such holders are available in stock and shall be used wherever service conditions permit.

3. **Gloves.** Always wear gloves when handling energized holders, cables, or machines and when removing or replacing electrodes. The gloves should be dry and in good condition.

4. **Dipping in Water.** Do not dip hot electrode holders in water because this would expose the operator to the chance of receiving an electric shock.

5. **Energized Holder.** Do not put an energized electrode holder under the arm at any time. When the energized electrode holder is not in use, the operator should place it where it will not be contacted by other personnel. If an insulated surface or insulated holding peg is not available, remove the electrode and lay the insulated holder on the deck or other adjacent object.

6. **Damp Clothing; Bare Skin.** Never permit the metal part of an electrode holder to touch either the bare skin or any damp clothing which the operator may be wearing.

11223 CABLE AND COUPLINGS

1. **Type.** Only approved welding cables of the completely insulated flexible type conforming

to the applicable requirements of N.D. BuShips Spec. 15C1 shall be used. They shall be capable of handling the maximum current requirements of the work in progress, taking into account the duty cycle under which the welding operator is working.

2. **Connectors and Couplings.** When it becomes necessary to connect lengths of cable, substantial insulated connectors of a capacity at least equivalent to that of the cable shall be used. Fully insulated "rapid couplings" are carried in standard stock and should be used whenever possible. If connections are effected by means of cable lugs, the lugs shall be soldered to the cable and securely fastened together to give good electrical contact. The exposed metal parts of the lugs, and the means used to fasten them together, shall be completely covered with rubber tape and protected with friction tape or equivalent protective covering. If any part of the connection is left bare, accidental contact with a metallic structure may cause sparks, arcs, and fires.

3. **Inspection.** Cables should be inspected once a month to see that they are in good condition.

4. **Bare Conductors.** When a cable (either work lead or electrode lead) becomes worn, exposing bare conductors, the exposed portion shall be protected by means of rubber and friction tapes or equivalent protection.

5. **Keep Cables Dry and Free of Oil.** Welding cables should be kept dry where practicable, and free from grease and oil, to prevent premature breakdown of the insulation.

6. **Transporting Cables.** When it becomes necessary to carry cables some distance from the machines, they should be substantially supported overhead, if practicable. If this cannot be done, and cables are laid on floor or ground, they should be protected in such a manner that they will not incur damage or interfere with safe passage of personnel. Special care should be taken to see that welding supply cables are not in proximity to power supply cables or high-tension wires.

7. **Looping Cable Over Shoulder.** Do not loop the welding cable over the shoulder (particularly over the shoulder opposite the hand holding the electrode holder). There is no shock hazard in this practice, but operators have

been dragged off staging or scaffolds when the cables were fouled by cranes, etc.

8. Separation of Cables. When using portable machines, care should be taken to see that the primary supply cables are separately laid and do not become entangled with welding supply cable.

11224 GROUND RETURNS

1. Frame Grounded. Before starting operations, the operator shall make certain that the welding machine frame is grounded, that neither terminal of the welding generator is bonded to the frame of the welding machines, and that all electrical connections are securely made. The ground connection should be attached firmly to the work, not merely laid loosely upon it.

2. Use of Structure or Pipe Line. Ground returns from the work to the machine should be made with a cable wherever practicable. However, under some operating conditions it may be necessary to utilize a structure or pipe line for the ground return. When such a structure is employed precautions against the creation of unsafe conditions must be taken.

3. Flammable Liquid Pipe Lines. Pipe lines

carrying gases or flammable liquids shall not be used for a ground return circuit.

4. Contact at Joints. When a structure or pipe line is used as a ground return circuit, it shall be checked to ascertain whether proper electrical contact exists at all joints. A condition of sparking or heating at any point should cause the rejection of the structure as a ground circuit, particularly if flammable vapors or gases may be present.

5. Avoid Current Through Bearings. Ground connection must be made in front of any bearings or similar joints in a structure or machine. Welding current going to ground through a bearing will almost invariably cause sparking and heating which will pit and ruin ball and roller bearings or other polished surfaces.

6. Joints Bonded and Inspected. Where a structure or pipe line is continuously employed as a ground return circuit, all joints shall be bonded and appropriate periodic inspection shall be conducted to ascertain that no condition of electrolysis or fire hazard exists as a result of such use.

7. Inspection. All ground connections shall be checked to determine that they are mechanically strong and electrically adequate for the required current.

Section 3

WELDING IN CONFINED SPACES

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Subsection A

VENTILATION STANDARDS

11301 HAZARDS OF INADEQUATE VENTILATION

Under conditions of improper ventilation, welding operations may create health hazards. These hazards are almost entirely due to:

1. the presence of gases, dusts, and fumes containing lead, zinc, cadmium, fluorine, or compounds thereof;
2. the possible formation of oxides of nitrogen;
3. extreme heat.

11302 VENTILATION REQUIRED

When any of the above hazards are present, either adequate forced ventilation shall be provided or an individual air respirator shall be worn by the operator.

11303 VARIABLES AFFECTING VENTILATION

The attention of commanding officers is in-

vited to the variables listed below which must be evaluated for their effect on calculations of minimum forced general ventilation requirements for spaces regularly used for welding operations:

1. dimensions of space, with special regard to height of ceiling;
2. number of operators (gas or electric);
3. composition and coatings of metals to be welded;
4. type and size of electrodes, and amperage used;
5. rate of welding;
6. variations in "natural" ventilation due to weather conditions;
7. whether welding fumes tend to rise quickly and blow away from operator due to convection currents; or tend to rise slowly and concentrate around operator's head before dissipation;

8. tendency of fumes to stratify above the working level;
9. tendency of fumes to form flocculent dust;
10. accident hazards involved in reduced visibility;
11. excessive deposits of fume-dust on other shop equipment;
12. excessive heat generated by gas and electric arc welding.

11304 SPACE CLASSIFICATION

Three space classifications have been adopted for convenience in setting ventilation standards, as follows:

- Class I: Spaces of 50,000 cubic feet and over
- Class II: Spaces of 5,000 to 50,000 cubic feet
- Class III: Spaces under 5,000 cubic feet

11305 WHERE POSITIVE VENTILATION NOT REQUIRED

1. **Outdoor Welding Operations.** For welding operations on uncoated ferrous metals conducted in the open air, positive ventilating devices or respiratory protective equipment are not required. However, where an operator is engaged in welding or cutting lead-bearing steels, lead or cadmium-bearing paint, whether indoors or out, an air-line mask or local exhaust ventilation shall be used. Where conditions do not permit their use, a filter-type respirator, approved for protection from lead fumes, may be used, but only for short intermittent periods of work.

2. **Class I Spaces.** Where welding of uncoated ferrous metals is the largest proportion of the work carried on in spaces over 50,000 cu. ft., positive ventilation is *not* required for the protection of welders *provided*:

1. welding bays are not structurally blocked, thereby obstructing cross ventilation;
2. no welding operations are on the inside of tanks, boilers, or other closed iron or steel containers;
3. a space allowance of 10,000 cubic feet is assured each operator.

11306 INDIVIDUAL VENTILATION DEVICES

1. **Exhaust Ducts.** Where welding of uncoated ferrous metals is the largest proportion of the

work carried on, an individual positive ventilation device for each operator shall be so designed and installed as to remove toxic fumes and dust at their source. This ventilation may be in the form of individual portable exhaust pipes, exhaust ducts from a central duct system, wall or roof fans, or any other equivalent means which will insure fume removal or dilution.

2. **Toxic Exhaust Fumes.** All ventilating devices installed, particularly portable temporary devices, shall be carefully scrutinized to insure that fumes, dust, etc., are not being exhausted into the same space or into other spaces, thus creating unrecognized hazards. Steps shall also be taken to insure that air replacing that withdrawn is clean and respirable.

3. **Hood Devices or Hose-Nozzles.** The effectiveness of either a hood device or hose-nozzle in removing fumes at their source depends upon the nearness of the intake openings to the welding operation. In the following table, which sets the minimum air-flow standards for removal of welding fumes, dusts, and gases at their point of origin, allowance is made for variables in the welding zone services, ranging from below 8 inches up to 15 inches from the arc or torch to the exhaust intake:

INDIVIDUAL POSITIVE VENTILATION
DEVICES FOR INDOOR WELDING
(on uncoated ferrous metals)

Welding zone distance to exhaust intake from arc or torch.	Class I 50,000 cu. ft. or over	Class II 5,000 to 50,000 cu. ft.	Class III under 5,000 cu. ft.
	Minimum air flow per operator— cu. ft. per minute		
Up to 8 inches----	200	225	250
8 to 10 inches----	250	275	300
10 to 12 inches----	300	350	375
12 to 15 inches----	350	400	450

11307 GENERAL SHOP OR SPACE VENTILATION

1. **Wall or Roof Fans.** During welding of uncoated ferrous metals in confined spaces where individual ventilating devices are unavailable,

a fan or fans (wall or roof) or other positive ventilating device shall be installed to insure fume dilution and general space ventilation at the following minimum air flow rate:

GENERAL SHOP VENTILATION,
WELDING UNCOATED FERROUS METALS

Space	Minimum air flow cubic feet per minute per operator	OR Complete air change ¹ each
Class I.....	350	20 minutes.
Class II.....	350	15 minutes.
Class III ² (space per operator)		
4-5,000 cu. ft.....	-----	4 minutes.
3-4,000 cu. ft.....	-----	3 minutes.
2-3,000 cu. ft.....	-----	2 minutes.
Less than 2,000.....	-----	1 minute.

¹ The volume of the space divided by the cfm. capacity of the blower, equals the theoretical time to change the air once.

² At least 1,000 cubic feet as well as the indicated space ventilation should be assured each operator.

2. Fan Efficiency. Particular attention is called to the necessity for selecting a type of fan capable of developing the required air volumes and pressure against the resistance of the exhaust system.

3. Screened Spaces. When electric welding must be performed in a space entirely screened on all sides, the screens shall be so arranged that no serious restriction of ventilation exists. It is desirable to have the screens mounted on end posts so that their bottom edges are about two feet above the floor unless the work is performed at so low a level that the screen must be extended nearer the floor to protect nearby workers from welding glare. In the latter case the screens must clear the deck by several inches.

**11308 INDOOR WELDING OF GALVANIZED
IRON OR STEEL, BRASS OR BRONZE**

1. Frequently and Regularly

a. CLASS I SPACES. The forced general ventilation prescribed in paragraph 11307 shall be increased by at least 10 percent; or the individual ventilation devices prescribed in paragraph 11306,3 shall be used.

b. CLASS II AND III SPACES. Individual ventilating devices prescribed in the table in para-

graph 11306,3 shall be provided. General shop ventilation standards are insufficient to protect the operator from the fumes of these metals.

2. Infrequently and Irregularly. (Class I, II, and III spaces). If these spaces are not already provided with the degree of ventilation prescribed in (a) above, it will be satisfactory to provide each welder working on galvanized iron or steel, brass, or bronze, with a portable individual ventilating device for use while such operations are being performed.

3. Inside Tanks or Closed Containers. When welding on galvanized iron or steel, brass, or bronze, inside tanks, or other closed containers, it shall be required that the operator be furnished an approved type of airline respirator or hose mask, and that its use is strictly enforced.

11309 EXPLOSIVE FUMES

1. Dangers. It must be borne in mind that certain gas and air mixtures such as acetylene and oxygen may accumulate in concentrations which are not toxic but may be explosive. The required ventilation shall be governed by the more dangerous condition.

2. Exhaust to Atmosphere. Utmost care shall be taken that the exhausted vapors are not allowed to discharge into any other compartment. Exhaust shall be only to the outside atmosphere. Hatches, companionways, ports, etc., in the vicinity of the exhaust shall be closed to keep vapors from drifting into other compartments. When necessary, temporary means shall be provided at the outboard ends of temporary exhaust tubes.

3. Do Not Use Oxygen. When forced ventilation of a space is required or used, it should *not* be accomplished by injecting oxygen in lieu of fresh air. Such a procedure is likely to raise the oxygen concentration of the air in the tank and substantially change the flammability limits.

4. Flame Arresters. Wire-gauze flame arresters shall be in place on tank vents used for outlets, and similar flame arresters shall be provided at the outboard ends of temporary exhaust tubes.

5. Blowers. If weather conditions are such that the exhausted vapors will not be quickly dissipated, air-motor-driven blowers or those driven by explosion-proof electric motors

should be used to assist in their dispersal. Electric blowers not equipped with explosion-proof motors shall not be used. If blowers are not used in quiet, humid weather, it is possible for

a stream of explosive vapor to drift several hundred yards to a source of ignition, from which a flame will flash back to the source of the vapors.

Subsection B

EXPLOSIVE AND TOXIC MATERIALS

11321 CERTIFICATION OF CLOSED COMPARTMENTS

1. Entry into Closed or Poorly Ventilated Spaces. No person shall enter any closed compartment or poorly ventilated space in any naval unit including naval or navy operated vessels unless and until a "gas-free" certificate has been issued by the safety engineer or his authorized representative to certify that the danger of poisoning or suffocation of personnel, or the danger of ignition or explosion of flammable gases has been eliminated or reduced to the lowest practical minimum.

2. Entry in Emergencies. In case of emergency, when it is necessary to send a man into a compartment or tank not certified as being gas-free or as containing sufficient oxygen, the man shall be equipped with an air-line mask or an oxygen rescue breathing apparatus. A line shall be securely fastened to him, the line being held by attendants outside who shall be prepared to haul him out if necessary. The men should use great care to see that this line does not become fouled. When using the air-line mask, the hose shall be attached to a source of air fit for breathing (*not* to an oxygen cylinder), and a slight positive pressure shall be maintained in the hose and face piece.

3. Hot Work in Way of Explosives or Flammables. No job involving hot work in way of flammable or explosive materials shall be undertaken until the gas-free tester or his authorized representative has:

1. indicated which precautionary measures are appropriate to make the space safe;
2. certified that applicable directions have been complied with so that men can work in the area without danger of poisoning or suffocation, and that hot work can be

undertaken without danger of fire or explosion.

11322 DEFINITION OF TERMS

1. Closed Compartments or Poorly Ventilated Spaces, are any spaces that are not well ventilated, or which have been closed for any appreciable length of time. Unventilated storerooms, blisters, double bottoms, tanks, cofferdams, pontoons, voids, idle furnaces, cold boilers, etc., are typical. The term also includes spaces which are normally occupied or regularly used, but which have been vacated and sealed because of damage, or for some other unusual reason.

2. Hot Work, is work involving welding, flame cutting, the use of open-flame equipment, or any work involving heating metal to or above a red heat. Riveting and any cold work involving the probability of striking sparks shall be considered as hot work, except when, in the opinion of the gas-free tester, circumstances do not necessitate such a classification (see article 92-454, BuShips Manual part 6). The precautions applicable to hot work shall apply to all other sources of flames, sparks, or intense heat, such as lighted cigarettes, open flame or electric cooking apparatus, non-explosive-proof lights, electric motors, etc.

3. In Way Of, means within, or on the exterior boundary of, spaces containing flammable or explosive materials; or anywhere in the vicinity of such materials (see below).

a. WITHIN. In addition to its obvious meaning, the term "within" also includes work performed from the *outside* of a space but which involves flame cutting, welding, or riveting through the plating, or which involves the possibility of heating to red heat the inside face of the plating or any other metal within the space.

For example, flame cutting through a bulkhead between two tanks is hot work *within both* tanks. It is *not* hot work "within" the tank the workmen are in and "on the exterior boundary" of the adjoining tank. In such a case, it is not permissible to inert the tank being cut into. Both tanks shall be cleaned and gas-freed.

b. **THE EXTERIOR BOUNDARY**, is the *outer* face of the plating surrounding a space, or any metal-work immediately contiguous thereto.

4. **In Vicinity Of**. Any location inside or outside the vessel where flammable or explosive materials are stowed, or where dangerous amounts of the materials or vapors therefrom may collect due to broken containers, overflow, seepage, air currents, or other causes shall be considered "in the vicinity of" the materials which are the source of the danger. This term includes the two immediately above, but the more specific terms are used when applicable.

5. Flammable or Explosive Materials

a. **EXPLOSIVES**. Explosives (bombs, warheads, depth charges, etc.); ammunition (gun, machine gun, small arms ammunition, pyrotechnics, etc.); rocket bodies, motors, etc., as listed in *Bureau of Ordnance Manual*.

b. **COMBUSTIBLES**. Combustibles (wood, cordage, bedding, etc.), and the "semisafe" and "dangerous" materials carried in relatively small quantities in cans, drums, etc., and listed in chapter 30 of the BuShips Manual.

c. **SEMISAFE AND DANGEROUS MATERIALS**. The "Semisafe", and "Dangerous" materials carried in bulk and listed in chapter 14 (*Bureau of Ships Manual*) are specifically, liquids, semi-solids, and solids capable of evolving flammable hydrocarbon or other organic gases or vapors at atmospheric temperatures or when heated. Alcohol, gasoline, diesel oil, fuel oil, and lubricating oil (and their residues) are typical liquids. Bitumastic compounds and coal are typical semi-solids and solids, respectively. Bulk quantities of oxygen supplying liquids, such as hydrogen peroxide, nitric acid, and liquid oxygen, are not included in the scope of this definition.

11323 GAS-FREE ENGINEER

1. **Qualifications**. In a naval unit such as a

ship, floating drydock, or shipyard, the gas-free engineer is a person qualified by training and experience to analyze hazardous conditions, especially with respect to entry into closed compartments and who has been authorized to decide in specific instances which precautionary measures shall be taken to safeguard personnel.

2. Responsibilities

1. He shall post a suitable label or tag near the entrance to the space or in some conspicuous location, describing the condition of the space.
2. Or he shall remain on the scene of operations until normal or safe conditions are restored.
3. He in turn may train and authorize competent persons to make preliminary inspections, gas tests, etc.
4. The gas-free engineer or his authorized representatives shall have authority to order men out of compartments or to suspend work whenever an unsafe condition is found to exist. However, he shall immediately notify the ship superintendent, or the repair superintendent, commanding officer, engineer officer, or other responsible authority of any such cessation of work and of the reasons therefor.

3. **Limitation of Authority**. When dictated by very urgent service requirements, the authority of the gas-free engineer may be abridged or relaxed as necessary but only with the approval of such authority as named in the preceding paragraph. Under such circumstances, and if it is practical to do so, the gas-free engineer shall be consulted as to the safest practical alternatives, and his recommendations shall be followed insofar as the circumstances permit.

4. **Locating Spaces According to Ship's Plans**. The engineer officer shall be consulted before opening any closed compartment aboard ship. If possible, the spaces to be opened or inspected shall be located by reference to the ship's plans. Reliance only on verbal information from the ship's personnel frequently results in opening the wrong space, which may have unforeseen and serious consequences.

5. **Information on Labels**. Every certificate, label, or tag issued by the gas-free engineer

shall give complete information regarding the compartment or space to which it applies, and the date and time it was issued. If it shows a **SAFE** designation, it shall also show the date and time after which the safe condition cannot be depended upon to exist and the safe notation is not valid. To minimize confusion and misunderstandings, the limitations and applicability of the safety notations as well as their definitions are given in the following paragraphs.

However, these definitions are not intended to indicate which conditions must be attained or whether to clean, gas-free, inert with gas, blanket with steam, or press-up the space. The procedures necessary to attain the conditions that the gas-free engineer has recommended and further definitions of terms are given in parts 3, 4, 5, and 6 of chapter 92 of the BuShips Manual.

11324 DEFINITIONS OF SAFETY NOTATIONS

1. **Colored Labels.** In connection with the requirements herein that the safety classification be shown on a tag hung outside a space, it is suggested that such tags be printed in various colors. It is suggested that red be used for "NOT safe for men—NOT safe for hot work" and green for "SAFE for men—SAFE for hot work". For all others, yellow is considered appropriate.

2. **Not Safe for Men—Not Safe for Hot Work.** To be used when the following conditions have been found to exist:

a. **POISON GASES.** Workmen are in danger of poisoning due to hydrocarbon or other gases in excess of the limits of toxicity either present or likely to be evolved under prevailing conditions; or they are in danger of suffocation due to oxygen deficiency.

b. **FLAMMABLE OR EXPLOSIVE SUBSTANCES.** There is danger of fire or explosion in the presence of hot work due to the existence of concentrations of flammable vapors within the limits of flammability; or due to the presence of residues likely to evolve dangerous amounts of flammable gases or vapors under the conditions prevailing; or due to the presence of flammable or explosive materials which are likely to be affected by the hot work; or due to the fact that

the surrounding spaces have *not* been protected as required.

3. **Safe for Men—Not Safe for Hot Work.** To be used when the following conditions have been found to exist:

a. **AIR SUITABLE FOR BREATHING.** Hydrocarbon or other gases in excess of the limits of toxicity are *not* present and are not likely to be evolved by the entry of workmen or by prevailing atmospheric conditions and the oxygen content of the air is sufficient for workmen.

b. **DANGER OF FIRE OR EXPLOSION.** There is danger of harm to workmen or of fire or explosion in the presence of hot work due to the existence of one or more of the same conditions enumerated in 2-b above.

4. **Safe for Men—Safe for Hot Work.** To be used when the following conditions have been found to exist:

a. **RESPIRABLE AIR.** Hydrocarbon or other gases in excess of the limits of toxicity are *not* present, and are not likely to be evolved under *any working conditions* likely to prevail and the oxygen content of the air is sufficient for workmen.

b. **NO FLAMMABLE OR EXPLOSIVE VAPORS.** Flammable or explosive materials or vapors have been removed, or adequately protected and surrounding spaces have been protected as required.

5. **Inerted—Not Safe for Men Inside—Safe for Men and Hot Work Outside.** To be used when the following conditions have been found to exist:

a. **SPACE FILLED WITH INERT GAS.** A nonflammable (inert) gas has been introduced into the space in the manner specified in Bureau of Ships Manual, article 92-461, et seq., and the concentration of inert gas is equal to or more than the minimum value specified in article 92-462(a), and will be maintained so continuously. The oxygen content of the air in the space will not support combustion or life.

b. **SPACE ISOLATED BUT FULL OF INERT GAS.** Adequate measures have been taken to isolate the space from occupied spaces, and to ensure that it will remain isolated until the inerting medium is disposed of.

6. **Pressed-Up with—Safe for Men and Hot Work Outside.** To be used when the following conditions have been found to exist:

a. **SPACE FILLED WITH WATER OR OIL.** The space has been entirely filled with water or oil (the certificate shall show which liquid has been used—no other liquids are permitted to be used).

b. **LEVEL OF LIQUID ABOVE WELDING AREA.** Means have been provided to verify that the level of the liquid remains at or above the topmost point of the space to be welded, and to insure that no person attempts to enter the space.

11325 EXPLOSIVES

1. **Removal from Welding Area.** When the gas-free engineer finds that contemplated hot work is in way of explosives, torpedoes, ammunition, etc., he shall comply with the Bureau of Ordnance provisions to remove all explosives to safe storage until normal conditions are restored.

2. **Responsibility for Moving.** If the requirement that explosives be moved is applicable, the gas-free engineer shall notify the gunnery officer (or the first lieutenant on ships not having gunnery officer), who will be responsible for having the moving of the explosives done in the manner prescribed in the Bureau of Ordnance Manual. The gas-free engineer shall not assume the responsibility of ordering that explosives be moved or of directing how they shall be moved; but he shall not issue a "SAFE" certificate for the space until he is satisfied that the explosives are a safe distance from the hot work. When he is satisfied, he shall classify and tag the space "safe for hot work."

11326 COMBUSTIBLE MATERIALS

1. **Cordage, Timber, or Bedding; Paints or Chemicals in Relatively Small Quantities in Cans or Drums; etc.** When hot work is contemplated in way of these materials, they shall be removed from the space, or steps shall be taken to protect the materials from the effects of the hot work. When the gas-free engineer is satisfied that adequate precautions have been taken, he shall classify and tag the space "safe for hot work."

11327 NAVAL VESSELS

1. **For General Repairs and Overhaul.** Vessels at commercial or naval shipyards, at sea or at advanced bases, or alongside repair ships shall empty, clean, and gas-free all bulk stowage

tanks, cofferdams, pumprooms, etc., and other spaces (such as shaft alleys, wells, sumps, bilges, and voids coated with bitumastic or filled with oil for corrosion protection) within which hot work is to be done and which is subject to accumulation of combustible or toxic gases. Bunker tanks containing fuel oil needed to keep steam up or to keep auxiliary machinery operating need not be emptied. Cargo-heating coils and cargo-smothering lines and vent lines shall be steamed and blown. Cargo pumps and cargo lines shall be blown with steam or flushed with water. Spaces thus cleaned and gas-freed shall be labeled "Safe for men—safe for hot work—EXCEPT on the piping."

2. **Piping.** Any piping, pumps, valves, etc. likely to contain flammable liquids (intake, discharge, distribution, and service systems; heating, displacement, and smothering and vent systems; and ladders, grabs, etc., made of tubing in bulk tanks), on which hot work will be done; or likely to be affected by hot work nearby; or not tight enough to prevent leakage into the space to be worked in or on shall be disconnected and blanked off, and shall be cleaned and gas-freed or inerted. The safety notation specified in the previous paragraph shall be modified to indicate which piping is "Safe" and which is "Not Safe". Other spaces containing substantial quantities of liquids in "package stowage" or as a result of an accident in a free state, shall be emptied by any practicable means.

3. **Care of Adjacent Area.** The gas-free engineer should not confine his attention to the vessel alone. Utmost care should be taken to avoid spilling flammable liquids into a drydock or allowing oil or oily waters to discharge overboard to create a serious fire hazard in harbor areas. When welding *inboard* alongside a pier, the pier in vicinity of the hot work should be "wet down" and any oil slick on the water around the vessel should be cleared. Waste, rags, etc. soaked with flammable liquids should be disposed of promptly and carefully.

4. **Restoring Operating Conditions.** When work is finished on a vessel, any tank vents, hatches, valves, etc. which were closed, locked, or sealed while hot work was in progress shall be checked to insure that proper operating conditions have been restored. This is especially important with

regard to tank vents in order to avoid damage when tanks are refilled. Inert gases in spaces which must be entered shall be dissipated as specified in article 92-462 (h), BuShips Manual, and the space made "safe for men."

5. Procedures. Special instructions and precautions for localized repairs involving hot work on the vessel in way of explosive or flammable cargo spaces, and for examination, cleaning, painting, and repairs not in way of cargo spaces are given in BuShips Manual chapter 92-402 (2), (3), 403, 421, and 422.

11328 SUSPECTED COMPARTMENTS

1. Gas-Free Engineer Responsible. Every closed compartment or poorly ventilated space, and all tanks, cofferdams, voids, bilges, etc., shall be considered UNSAFE for hot work until the gas-free engineer has inspected the space and has indicated that adequate safety measures have been taken.

2. Naked Lights. Matches, cigarette lighters, open flames, ordinary electric lights, flashlights, or any sparking electric apparatus shall not be allowed in suspected compartments or in the vicinity of open hatches, etc., leading thereto. Portable lights used by cleaning parties shall be of the steamtight globe type, with any exposed metal parts of a nonsparking alloy or protected against striking a spark.

3. No Smoking. Smoking shall not be permitted in confined spaces or areas.

4. Fire Extinguishers. Suitable fire extinguisher apparatus shall be provided in the vicinity of unsafe compartments or spaces.

5. Adjacent Spaces. Each space that is subject to accumulation of hydrocarbon or other gases and is in contact with a space in or on which repairs will be made (including spaces in contact at the corners or in contact with the top or bottom) shall be inerted. Classify and label "INERTED—NOT safe for men INSIDE—Safe for men and hot work OUTSIDE." In the case of a minor repair, only those contacting spaces need be inerted which, in the judgment of the gas-free engineer, may possibly be affected by the hot work (as when working on the boundary of a tank but very close to the bulkhead between it and another tank). Other contacting spaces need not be inerted for a minor repair.

6. Regeneration of Gas. The possibility of regeneration of gas due to open pipes or other connections between clean and dirty tanks should be recognized and guarded against.

7. Drifting Fumes. Care shall be taken to insure that hatches, pipes, passageways, companionways, innerbottoms, etc. subject to gas accumulation, and not cleaned or inerted, are kept closed and that vents are so arranged that flammable fumes or vapors cannot drift into the vicinity of the hot work. Tanks in which there is piping on which men are working, and spaces or piping that are inerted, should be isolated from other spaces containing toxic flammable liquids or vapors by blanking off interconnecting pipe lines, or by closing valves and securing with rope or seizing wire or other suitable measures.

8. Leakage. In addition to the cargo tanks, service tanks, ballast tanks, settling tanks, and other compartments in which flammable liquids are present intentionally, it will be found that toxic flammable vapors from dripping of liquids from pipe joints, pumps, valves, and leaky containers or from seepage, drainage, or other causes, often contaminate the air in pumprooms, cofferdams, cargo holds, voids, shaft alleys, sumps, bilges, etc.

9. Coated Containers. Compartments which are often coated with bitumastic or filled with oil for corrosion protection, and which become filled with flammable vapors when heated, include voids, rudders, skegs, ramps (for landing craft), struts (fabricated), and water tanks.

10. Water Tanks. Always use care in entering or working on water tanks. Even if they are not coated with bitumastic, or are not near enough to oil tanks to be subject to oil leakage, they frequently contain explosive, toxic methane (marsh gas) from the decomposition of organic materials in stagnant water.

11. Changing Conditions. Shifting of ballast, disconnecting of pipe lines, shifting of the vessel from one berth to another, and similar operations may result in release of flammable liquids or vapors. If such operations are done after a "SAFE" certificate has been issued, particular care should be exercised to insure that an unsafe condition has not been created.

12. For Examination, Cleaning, and Painting. When a vessel is in a naval shipyard for this purpose, the gas-free engineer shall exercise extra vigilance to make sure that incidental repairs involving hot work for which the need has become evident in the course of other work, are not undertaken until the location has been inspected and any necessary safety measures taken. While the vessel is in the shipyard, all spaces subject to gas accumulation shall be kept closed; or shall be opened and entered only after the proper precautions as prescribed by the gas-free engineer have been taken.

11329 AIR SAMPLING AND ANALYSIS

1. Testing Air. The air in tanks which have been empty for a long time and the air in other closed or poorly ventilated spaces shall be tested for the presence of toxic or flammable concentrations of hydrocarbon or other vapors. Air conditions shall be checked with the flame safety lamp and the combustible gas or carbon monoxide gas indicator or by chemical analysis as frequently as circumstances appear to require. A check shall be made before men enter if work has been suspended overnight or for any similar period. Persons entering spaces for gas tests should be equipped with fresh-air-line masks and lifelines tended by reliable men outside. If one or more of the tests show any positive indication of the presence of any flammable vapor, regardless of whether it is below, within, or above the explosive range, the space shall be gas-freed and cleaned by the applicable procedures indicated in BuShips Manual 92-451-454.

2. Flame Safety Lamp. The flame safety lamp is generally to be used only to show the presence or absence of sufficient oxygen to support life, but the presence or development of other dangerous conditions is indicated by the action of the flame as follows:

1. flame dies out—Deficiency of oxygen (less than 16 percent);
2. flame goes out with slight "pop"—Explosive concentration of gas;
3. flame flares up then goes out—Rich concentration of explosive gas;
4. flame flares up brightly—Lean concentration of explosive gas.

3. Combustible Gas Indicators. These indicators are capable of detecting all mixtures of air

or oxygen with combustible gases or vapors from fuel oils, gasoline, alcohol, acetone, etc. and of illuminating or fuel gas, hydrogen, and acetylene. They are sensitive in showing the presence of concentrations of these vapors or gases up to the lower explosive limit and give an accurate measurement of the percentage concentrations of the mixture if it is in or beyond the explosive range. They are *not*, however, sufficiently sensitive to measure accurately the small concentrations of flammable gases which can have an appreciably toxic effect when breathed for an extended period of time (8 hours or more). Nor do they detect nonflammable gases which are toxic.

4. Carbon Monoxide Indicators. These devices are much more sensitive in detecting carbon monoxide than the combustible-gas indicators but are limited to the detection of this one gas.

5. Determination of Safe Conditions. There is satisfactory assurance of freedom from toxic concentration of flammable gases when:

1. the space has been thoroughly ventilated;
2. tests with the combustible-gas indicators (and with the carbon monoxide indicators when available) have given *no* indication of the presence of combustible gases (if any gas is indicated by the instrument, even though below the flammability limit, it is probable that the concentration is above the toxicity limit); and
3. tests with the flame safety lamp have indicated no oxygen deficiency.

6. Physical Symptoms Indicating Toxic Gas. The conditions noted above do not give positive assurance of freedom from toxic concentrations of nonflammable gases, such as carbon-dioxide, nitrogen, carbon-tetrachloride vapors, etc. However, when the space has been thoroughly ventilated, and there is no oxygen deficiency as indicated by the flame safety lamp, workers in such atmospheres will receive warning of danger through such symptoms as labored breathing, excessive fatigue from slight exertion, dullness, etc., a considerable time before more serious reactions are experienced.

11330 TOXIC GASES

1. Physical Effects of Petroleum Vapor. Breathing of the vapors from petroleum products gives effects ranging from mild exhilaration, through

irritation of the eyes, severe headache and complete intoxication, to unconsciousness and death. The effects become more pronounced as the percentage of concentration and time of exposure are increased. An added danger associated with breathing these vapors is the danger of accidents resulting from the dizziness induced by small concentrations not otherwise harmful.

2. Toxicity Limits. These gas concentrations of several hydrocarbons and of hydrogen sulfide as itemized in article 92-459 (BuShips Manual) are generally accepted as the maximum concentration to which men can be exposed without harmful effects. These toxicity limits are also very much lower than the flammability limits of these gases.

3. Use Masks if in Doubt. The usual portable combustible gas indicators are not sensitive enough to determine whether or not a small concentration of combustible gas is above or below the toxicity limit. If accurate determination of the gas concentration is desired, chemical laboratory analyses of air samples are necessary. However, the safest procedure is to eliminate dangerous gases and vapors entirely, or to use air-line masks when working for extended periods in suspected atmospheres.

4. Carbon Monoxide. Carbon monoxide may be present in compartments painted with a linseed oil base paint and sealed immediately thereafter.

5. Hydrogen Sulfide. Hydrogen sulfide and other toxic gases will be generated by mildewing or rotting foodstuffs or other organic matter, such as cloth, leather, and wood. Mildewing and rotting are accelerated when the space is warm and humid, as when cruising in the tropics, or when an area has been flooded as a result of damage or accident.

6. Carbon Dioxide. An excess of carbon dioxide is frequently found in refrigerator spaces even though the spaces are undamaged and the foodstuffs are perfectly edible. This is due to the lack of ventilation and the tendency of foods to absorb oxygen slowly and give off CO_2 . The concentration is rarely high enough to be dangerous unless a man stays in the space longer than a few minutes at a time, in which case he is liable to be overcome and eventually suffocated.

7. Rusting Metal. Oxygen deficiency can be caused by the rusting of metal in a tank which has been cleaned to bare metal and then sealed.

8. Additional Hazards. The above examples are only a few of the many ways dangerous conditions can occur in poorly ventilated spaces, and illustrate the necessity for careful adherence to safety precautions.

11331 GAS FREEING CONTAMINATED SPACES

1. Containers of Flammable Substances. Welding, cutting, or other work involving heat or sparks should never be done on barrels, used drums, tanks, or other containers which have held a flammable substance until they have been cleaned so thoroughly as to make absolutely certain that no flammable solids, liquids, or vapors are present.

2. Tools. In cleaning contaminated spaces, all tools, including hose nozzles, scrapers, buckets, etc., shall be of rubber, wood, copper, brass, or fiber, so as to minimize the risk of striking sparks.

3. Gasoline Tanks. In addition to regular procedures, the cleaning of gasoline tanks shall be undertaken only by vessels equipped with portable air-motor-driven ventilating sets. Cleaning of gasoline tanks on vessels not so equipped shall be done only in naval shipyards, except in imperative emergency. See BuShips Manual 92-452 for safe operating procedures and for personnel protection.

4. Scale on Plating. When thoroughly cleaning a tank, sludge or scale on the plating should receive special attention. Oils with high sulfur content and gasolines are particularly corrosive and scale-forming, and such coating holds liquids like a sponge. The space may appear clean and gas indications may be negative, but when the scaled plates are heated, entrapped liquid will probably vaporize and mix with the large volume of air to form an explosive mixture. In removing scale, care should be taken to avoid chipping through thin plating, especially on destroyers, etc.

5. Opening Sealed Compartments. In any sealed tank or compartment, especially those closed because of damage, there is always the

possibility that pressure has been built up inside. Whenever possible, the seal around the manhole or other opening should be broken before all hold-down bolts or other fastenings are completely removed. This will prevent the cover or door from being flung violently against the men nearby in case there is pressure behind it, and will enable the cover to be replaced if there is water or gas behind it that threatens to flood the next compartment.

6. Inaccessible Spaces. Particular care should be taken in cleaning spaces with extremely limited accessibility such as barges and inner-bottom tanks.

11332 CLEANING METHODS

1. Steam Cleaning Method. This method is most commonly used to remove materials which are easily volatile. The equipment and materials required for steam cleaning are simple and available to almost any naval activity. Safe operating procedures are described in Section 92-451, BuShips Manual.

2. Other Recognized Processes. Cleaning with chemical compounds such as caustic soda, and the conditions under which cleaning may be abridged or omitted are outlined in 92-453 and 92-454, BuShips Manual.

3. Carbon-Tetrachloride Prohibited. "Carbon-tet" shall *not* be used to clean surfaces of oil tanks, etc. However, it is so well known as a grease solvent that this prohibition may have been overlooked, and it may have been employed and residues may be present. If the residues are heated, the phosgene liberated might be dangerously concentrated for a man standing or leaning over the heated area, as in welding.

11333 INERTING AND PRESSING UP

1. Inerting with Gas. In an apparently clean container there may still be traces of oil or grease under the seams even though the vessel may have been cleaned and flushed with caustic soda solution. The heat of the welding or cutting operation may cause such oil or grease to give off flammable vapors to the extent that an explosive mixture may be formed inside the container. Such mixtures can be prevented from burning or exploding by mixing in a quantity of an inert or nonflammable gas equal to a sub-

stantial percentage of the volume of the vapor-air mixture. Carbon-dioxide, nitrogen, and helium are suitable for this purpose.

2. Blanketing with Steam. In the necessity for making emergency repairs and when it is impractical to obtain or use one of the inert gases or to clean and gas-free the spaces, steam may be used in lieu of inert gas to blanket the compartment. However, steam shall *never* be used under any circumstances in spaces containing flammable materials in closed containers, or in magazines or spaces adjoining magazines.

3. Pressing-Up. Pressing-up is an alternative to inerting. In this procedure, the tank or space shall be completely filled with water, fuel oil, or lubricating oil. The gas-free engineer shall take steps to ensure that there are no pockets between structural members, or on the high side under a slanting top, or on a listed ship into which the vapor-air mixture will be compressed and from which the liquid will be excluded.

4. Venting of Containers. Make sure that jacketed container or other hollow parts are sufficiently vented before heating, welding, or cutting. Remember that air or any other gas which is confined inside a hollow part will expand greatly when heated. The internal pressure created may be sufficient to cause the part to act like a bomb.

5. Be Suspicious of Light Metal Parts. A metal part which is suspiciously light is probably hollow, and should be drilled to vent it before heating. Every possible precaution should be taken with jacketed vessels, tanks, or containers to vent the confined air sufficiently before doing any hot work.

6. Vents. Vents and telltales shall be provided when needed, to eliminate vapor pockets and to verify the liquid level. However, drilling and tapping for them shall *not* be permitted on gasoline or alcohol tanks, but may be done on other tanks. Drilling and tapping shall be done *slowly* under a steady stream of water.

7. Oil Filled Spaces. Spaces entirely filled with oil should be vented before heating to prevent damage due to expansion of the oil.

8. Safe Operating Procedures. For inerting and pressing up of contaminated spaces, details are given in BuShips Manual section 92-461, 462, and 464.

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United States Navy
SAFETY PRECAUTIONS

Chapter 12
WOODWORKING

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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12101 APPLICATION AND SCOPE

1. **Applicability.** These safety precautions shall apply to all woodworking machinery and equipment used ashore and afloat. The provisions of American Standard safety codes shall be used insofar as they may be applicable as guides in securing the correction of hazards or hazardous conditions not specifically covered herein.

2. **Other Machines Not Excluded.** The mention of specific machines is not intended to exclude other woodworking machines from the requirement that suitable guards and exhaust hoods be provided to reduce the operational hazards. The absence of a safety precautionary measure covering any specific equipment, operation, or hazard does not relieve management from the responsibility of providing reasonable safety measures.

12102 INSTRUCTION OF PERSONNEL

1. **Experienced Operators.** No person without experience shall be permitted to operate any woodworking machinery until he has been instructed as to the hazards and the proper operation of such equipment and the use of protective devices.

2. **Sharpening Saws.** No workman shall attempt to file or sharpen a saw unless he is qualified and has been properly authorized to perform such work.

3. **Guards.** Guards shall be installed wherever possible and their use explained and enforced. If special operations and the making of repairs or adjustments require the removal of the guard, it shall be immediately replaced upon completion of the work which required its removal. No person shall be permitted to remove a guard or to operate the machine without the guard except with the consent of his supervisor.

12103 WORKING AREAS

1. **Floors.** All floors shall be kept in good repair and shall be free from protruding nails, splinters, holes, unevenness, and loose boards. Effective means shall be provided to prevent slipping.

2. **Aisles.** Aisles shall be maintained of sufficient width to permit the uncrowded and safe passing of personnel, trucks, or material. Where practicable, lines shall be painted on the floor or some similar method shall be employed to mark aisles.

3. **Illumination.** During all working periods each working area, operation, or process shall

be adequately lighted and harmful glare avoided. The illumination shall not be less than the minimum foot-candles given in the following table:

MINIMUM FOOT CANDLES IN SERVICE	
<i>Representative activity</i>	<i>Foot-candles</i>
Rough sawing and bench work -----	15
Sizing, planing, rough sanding, medium machine and bench work, gluing ----	20
Fine bench and machine work, fine sanding and finishing -----	50

For activities and locations not included in the above list, illumination not less than the "Minimum foot-candles in service", given for like situations in the American Standard Association Code A-11-1942 shall be considered adequate. A brief table will be found in 02214.

12104 DEFECTIVE EQUIPMENT

1. **Hazardous Defects.** Tools, machines, devices, or other equipment that is hazardous because of defects or other conditions shall not be used until suitably repaired. All cracked saws shall be removed from service.

2. **Wedges.** The practice of inserting wedges between the saw disk and the collar to form what is commonly known as a "wobble saw" shall not be permitted.

3. **Saw Defects.** Dull, badly set, improperly filed, or improperly tensioned saws, shall be immediately removed from service as soon as they begin to cause the material to stick, jam, or kick back when it is fed to the saw at normal speed. A saw to which gum has adhered on the sides shall be immediately cleaned.

12105 CARE OF EQUIPMENT

1. **Knives.** All knives and cutting heads shall be kept sharp, properly adjusted, and firmly secured. Where two or more knives are used in one head, they shall be properly balanced.

2. **Arbors.** Arbors of all circular saws shall be free from play.

3. **Bearings.** Bearings shall be kept free from lost motion and shall be kept well lubricated.

12106 SAFETY EQUIPMENT

1. **Push Stick.** A push stick made of a narrow strip of wood or similar material with a notch

cut in one end and shaped on the other end to provide a good hand grip shall be used to push material through saws where there is possibility of the operator's fingers coming in contact with blades at point of operation.

2. **Push Block.** A push block of wood or similar material having a handle like a hand plane and a notch or shoulder at the rear end shall be used to push short stock over the jointer knives.

3. **Jig.** A jig or fixture shall be used when cutting or forming irregular pieces or oblique angles.

4. **Fillister.** When narrow strips are cut a fillister piece about 2 inches wide shall be used between the fence or gage and the material being cut. It shall be firmly secured to the table or to the fence by cleats, clamps, or other effective means.

5. **Guards for Moving Parts.** Adequate safeguards shall be provided for all moving parts of equipment used in the mechanical transmission of power, including prime movers and intermediate equipment. Driven machines, such as engines, motors, connecting rods, cranks, fly wheels, shafting, spindles, pulleys, belts, link belts, chain, ropes, rope drives, gears, sprockets, friction drums, cams, couplings, clutches, counter-weights, revolving, or reciprocating parts shall also be guarded, up to the point of operation.

6. **Guards for Projections.** All projecting keys, setscrews, and other projections in revolving parts shall be made flush or guarded by a substantial metal cover. This does not apply to keys or setscrews within a gear pulley or sprocket casting or other enclosure; nor to keys, setscrews or oil cups in hubs of pulleys less than 20 inches in diameter where they are within the plane of the rim of a pulley.

7. **Exhaust Hoods.** All power saws shall be guarded under and behind the table to prevent possible personal contact. Exhaust hoods will be considered as adequate under or rear guards.

8. **Power Cut-Off.** A mechanical or electrical power control shall be provided on each machine which will make it possible for the operator to cut off the power from the machine being operated without leaving his position at the point of operation.

9. Belt Shifter. In machines driven by belts and shafting, a locking-type belt shifter or an equivalent position device shall be used.

12107 DUST CONTROL

1. Where Necessary. Each activity containing 4 or more woodworking machines whose operations create dust, shavings, chips, or slivers shall be equipped with an exhaust system either continuous or automatic in action, of sufficient strength and capacity to remove such refuse from the points of operation and immediate vicinities of machine and work places.

2. Size. All exhaust pipes or ducts shall be of such size as to minimize the possibility of clogging. They shall be readily accessible for cleaning. All exhaust pipes or ducts shall empty into dust-tight settling chambers and shall be so constructed that dust cannot be discharged into adjoining areas.

3. Fire Prevention. The settling or dust chamber shall be of fire-resistant construction and shall be so designed and operated as to reduce to a minimum the danger of dust explosions. The volume of accumulated refuse shall be held to a practical minimum.

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Subsection A

SHOP SAFETY

12201 CIRCULAR SAWS

1. Operating Precautions

a. CHOICE OF SAW. Do not use a rip saw for cross-cutting or vice versa. Cross-cut saws can be used for ripping but they are not intended for such work and should not be so used.

b. CONDITION OF SAW. See that saw is in good condition before you start to use it. This means sharp, unbroken, and free from cracks, and the proper saw for the job. The blade shall be changed if dull, cracked, chipped, or warped.

c. SETTING. Be sure saw is set at proper height above the table to cut through the wood.

d. KICKBACKS. Avoid "kickbacks" by standing to one side of the saw—not in line with it.

e. PUSH STICK. Always use a push stick to push short narrow pieces between the saw and the gage.

f. DEBRIS. Keep material of any kind from accumulating on the saw table.

g. REACHING. Never reach over saw to obtain material from the other side.

h. FEEDING. When cutting, do not feed wood to saw faster than the saw will cut freely or clean.

i. ATTENTION. Never leave the sawing machine unattended with the power turned on.

2. Speed. Circular saws shall not be operated at speed in excess of 10,000 peripheral feet per minute unless especially tensioned for higher speeds, in which case the manufacturer will etch upon the saw the speed at which it should operate. These etched speeds shall not be exceeded.

The following table shows revolutions per minute for various diameters of saws with the peripheral speed of 10,000 per minute:

Diameter of saw		Diameter of saw	
(inches)	R.P.M.	(inches)	R.P.M.
8-----	4,774	20-----	1,910
10-----	3,819	22-----	1,736
12-----	3,183	24-----	1,529
14-----	2,728	26-----	1,469
16-----	2,387	28-----	1,364
18-----	2,122	30-----	1,273

3. Hand-Fed Ripsaws

a. HOODS. Each circular hand-fed rip saw shall be guarded by a hood which shall completely enclose that portion of the saw above the table. The hood and mounting shall be so arranged that the hood will automatically adjust itself to the thickness of, and remain in contact with the material being cut. The hood shall be of adequate strength to resist blows and strains incidental to reasonable operation, ad-

justing and handling, and shall be so designed as to protect the operator from flying splinters and broken saw teeth.

b. ALIGNMENT OF HOOD. The hood shall be so mounted as to insure its operation to be positive, reliable, and in true alignment with the saw; and the mounting shall be adequate in strength to resist any reasonable side thrust or other forces tending to throw it out of line.

c. SPREADERS. Each hand-fed circular rip saw shall be furnished with a spreader to prevent material from squeezing the saw or being thrown back on the operator. The spreader shall be made of saw steel or tool steel which has been hardened, tempered, and ground to gage so that it is thinner than the saw kerf but thicker than the saw blade. It shall be of sufficient width to provide adequate stiffness or rigidity to resist any reasonable side thrust or blow tending to bend or throw it out of position. The spreader shall be so attached as to remain in true alignment with the saw even when either the saw or table is tilted, and shall be so placed that there is not more than $\frac{1}{2}$ inch space between the spreader and the back of the saw when the largest saw is mounted in the machine.

The provision of a spreader in connection with grooving, dadoing, or rabbeting is not required. On the completion of such operations, the spreader shall be immediately replaced.

d. NONKICKBACK FINGER OR DOG. Each hand-fed circular rip saw shall be provided with one or more nonkickback fingers or dogs mounted on the hood and so located as to oppose the thrust or tendency of the saw to pick up the material or to throw it back toward the operator. They shall be designed to provide adequate holding power for all thicknesses of materials being cut.

4. Hand-Fed Crosscut Table Saws (Including Trimmer Saws). Each circular crosscut table saw shall be guarded by a hood which shall meet all the established requirements.

5. Swing and Sliding Cut-Off Saws

a. HOOD NECESSARY. Each swing or sliding cut-off saw shall be provided with a hood that will completely enclose the upper half of the saw, the arbor end, and the point of operation at all positions of the saw. The hood shall be constructed in such a manner, and of such material, that it will protect the operator from flying

splinters and broken saw teeth and will afford the operator a clear view of the cutting edge of the saw at all times.

b. HINGED HOODS. The hood shall be hinged at the back and provided with an extension at the front so that when the saw is returned to the back of the table, the hood will rise on top of the fence; and when the saw is moved forward, the hood will drop on the top of, and remain in contact with, the material being cut.

c. SAW TABLES. Each swing and sliding cut-off saw table shall be extended at the point of operation wide enough to maintain table surface below the exposed edge of the saw blade to the full extent of the travel of the saw.

d. COUNTERWEIGHTS. Each swing cut-off saw shall be provided with an effective device to return the saw automatically to the back of the table when released at any point of its travel. Such device shall not depend for its proper function upon any rope, cord, or spring. If there is a counterweight, the bolts supporting the bar and counterweight shall be provided with cotter pins; and the counterweight shall be prevented from dropping by either a bolt passing through both the bar and counterweight, or a bolt put through the extreme end of the bar, or, where the counterweight does not encircle the bar, a safety chain should be attached to it.

e. LIMIT STOPS. Each swing cut-off saw shall be provided with limit chains or other equally effective device to prevent the saw from swinging beyond a front or back position where the gullets of the lowest teeth will rise above the table top.

6. Inverted Swing Cut-Off Saws. Inverted swing cut-off saws shall be provided with a hood that will cover the part of the saw that protrudes above the top of the table or above the material being cut. It shall automatically adjust itself to the thickness of, and remain in contact with, the material being cut.

7. Revolving Double Arbor Saws. Revolving double arbor saws shall be fully guarded in accordance with all of the requirements for circular crosscut saws or with all of the requirements for circular rip saws.

8. Circular Resaws

a. SHIELDS. Each circular resaw shall be

guarded by a hood or shield of metal above the saw. Such hood or shield shall be so designed as to guard against danger from flying splinters or broken saw teeth.

b. SPREADER. Each circular resaw (other than self-feed saws with a roller or wheel at back of the saw) shall be provided with a spreader fastened securely behind the saw. The spreader shall be slightly thinner than the saw kerf and slightly thicker than the saw disk.

9. Self-Feed Circular Saws

a. HOODS. Feed rolls and saws shall be protected by a hood or by semicylindrical guards to prevent the hands of the operator from coming in contact with the in-running rolls at any point. The guard shall be constructed of heavy material, preferably metal, and the bottom of the guard shall come down to within $\frac{3}{8}$ inch of the plane formed by the bottom of working surface of the feed rolls.

b. NONKICKBACK FINGERS. Each self-feed circular rip saw shall be provided with sectional nonkickback fingers for the full width of the feed rolls. They shall be located in front of the saw.

10. Portable Circular Saws

a. GUARDS. All portable, power-driven saws shall be equipped with guards which will automatically adjust themselves to the work when in use, so that none of the teeth protrude above the work. The guard over the blade shall be adjusted so that it slides out of its recess and covers the blade to the depth of the teeth when the saw is lifted off the work.

b. FACE PROTECTION. Goggles or face shields shall be worn while using the saw and while cleaning up debris afterward.

c. GRASP SAW FIRMLY. Saws are to be grasped with both hands and held firmly against the work. Care shall be taken that the saw does not break away, thereby causing injury.

d. INSPECTION OF BLADE. The blade shall be inspected at frequent intervals and always after it has locked, pinched, or burned. The electrical connection shall be broken before this examination.

e. OVERLOADING MOTOR. The saw motor shall not be overloaded by pushing too hard or cutting stock that is too heavy.

f. EXAMINATION OF MATERIAL. Before using

the saw, the material to be cut shall be carefully examined and freed of nails or other metal substances. Cutting into or through knots shall be avoided as far as possible.

g. MAKING REPAIRS. The electric plug shall be pulled before any adjustments or repairs are made to the saw. This includes changing the blade.

12202 BAND SAWS

1. General

a. TESTING FOR DEFECTS. Band saw wheels should be tested by experienced men at least once a week with a small machinist's hammer to detect cracks or loose spokes. The sound of a cracked or broken wheel is dull and flat.

b. CRACKED BLADE. Cracked blades should not be used. If a blade develops a "click" as it passes through the work the operator should shut off the power, as the click is a signal that the blade is cracked and may be ready to break. After the saw blade has stopped moving, it should be replaced with one in proper condition.

c. BROKEN BLADE. If the saw blade breaks, the operator should shut off the power, and not attempt to remove any part of the saw blade until the machine is completely stopped.

d. FREE WORKING BLADE. If the work binds or pinches on the blade, the operator should never attempt to back the work away from the blade while the saw is in motion since this may break the blade. He should always see that the blade is working relatively freely through the cut.

e. DANGER FROM COLD. A band saw preferably should not be operated in a location where the temperature is below 45 degrees Fahrenheit as it may break when the machine is started.

f. SIZE OF SAW. Using a small saw for large work or forcing a wide saw on a small radius is bad practice. The saw blade should in all cases be as wide as the nature of the work will permit.

g. STOPPING SAW. Band saws should not be stopped too quickly by thrusting a piece of wood against the cutting edge or side of the band saw immediately after the power has been shut off because the blade may break. Band saws 36 inches and larger shall have a hand or foot brake.

h. BRAZING. Particular care should be taken when sharpening or brazing a band saw blade

to see that the blade is not overheated and that the brazed joints are thoroughly united and are finished to the same thickness as the rest of the blade. It is recommended that all band saw blades be butt welded where possible, as this method is much superior to the old style of brazing.

2. Band Saws and Band Resaws

a. ENCLOSING BLADE. All portions of the saw blade shall be enclosed or guarded, except the working side of the blade between the guide rolls and the table. Band-saw wheels shall be fully encased.

b. GUARDS. The outside periphery of the enclosure shall be solid. The front and back of the band wheels shall be enclosed by solid material, sheet metal or casting, or perforated metal. The sheet metal is to be not less than 0.037 inches (U.S. Gage No. 20). The guard for the portion of the blade between the sliding guide and the upper-saw-wheel guard shall enclose the saw blade on all sides.

c. SELF-ADJUSTING GUARD. This portion of the guard shall be self-adjusting to raise and lower with the guide. The upper wheel guard shall be made to conform to the travel of the saw on the wheel and the top member of the guard shall have at least a 2-inch clearance outside the saw.

d. AUTOMATIC TENSION. Each band-saw machine shall be provided with an automatic tension control device to prevent breakage of saw blades due to improper tension.

e. FEED ROLLS. Feed rolls of band resaws shall be protected with a semicylindrical guard to prevent the hands of the operator from coming in contact with the in-running rolls at any point. The guard shall be constructed of heavy material, preferably metal, and the edge of the guard shall come to within $\frac{3}{8}$ inch of the plane formed by the inside face of the feed roll in contact with the stock being cut.

12203 SHAPERS

1. Inspection. Shapers shall be inspected before use. They shall be free of cracks and dirt, and they shall be sharp.

2. Removing Blades. When one blade is removed from a shaper spindle for sharpening or for some other purpose, all other blades should be removed at the same time. This is to prevent

other blades from being hurled from the spindle in case the machine is started accidentally.

3. Starting and Stopping Device. All double-spindle shapers shall be provided with a spindle starting and stopping device for each spindle.

4. Cleaning and Repairing. The power shall be turned off and steps taken to insure that it will not be turned on before the cleaning, adjusting, or repairing of the shaper is completed.

5. Speed. The correct speed shall be used while shaping. This may vary with the type of cutter or material. The supervisor shall be consulted in case of doubt.

6. Table Guide. When a table guide is used, the operator should be sure that it is well fastened and will not slip.

7. Knives

1. Only sharp knives of the same bevel and balance, free of burns or other imperfections, should be used.

2. Short knives should not be used. They are dangerous because the shaper collars do not get enough bearing to hold the knives securely.

3. Before tightening the knives in place, the operator should make sure the collar surfaces are free of burrs or foreign material which will prevent the knives from having an adequate bearing.

8. Cutting Techniques

1. Operators should not "back up" on a cut. Running material in the direction of rotation of the spindle, instead of against it, is dangerous.

2. Operators should avoid taking deep cuts or feeding the stock too rapidly or with too great pressure.

9. Machining Wood. Operators should be particularly careful in machining wood that contains cross grains or knots, as these may cause the hands to be thrown into the knives or cause kickbacks.

10. Protection of Hands. Operators should not rest their hands near edge of material being cut.

11. Protection of Face. Goggles or face shield shall be worn while shaping.

12. Guards. The cutting heads of each wood shaper, hand-fed panel raiser, or other similar machine not automatically fed shall be enclosed

with a cage or adjustable guard so designed as to keep the operator's hands away from the cutting edge. The diameter of circular shaper guards shall be not less than the greatest diameter of the cutter. In no case shall a warning device of leather or other material attached to the spindle be acceptable.

13. Cylindrical Heads. Cylindrical heads shall be used wherever the nature of the work will permit. Templates, jigs, and fixtures which will remove the operator's hands from the point of operation shall be used wherever the nature of the work will permit.

14. Kick-Back. A kick-back-preventer shall be used when possible.

12204 TENONING MACHINES

1. Guards. Each tenoning machine shall have all cutting heads, and saws if used, covered by metal guards. These guards shall cover at least the unused part of the periphery of the cutting head. If such guard is constructed of sheet metal, the material used shall be not less than $\frac{1}{16}$ inch in thickness; and if cast iron is used, it shall be not less than $\frac{3}{16}$ inch in thickness.

2. Exhaust Hood. Where an exhaust system is used, the guard shall form part or all of the exhaust hood and shall be constructed of a metal of a thickness not less than the above.

3. Feed Chains and Sprockets. Feed chains and sprockets of all double and tenoning machines shall be completely enclosed, except that portion of chain used for conveying the stock. At rear ends of frames over which feed conveyors run, sprockets and chains shall be guarded at sides by plates projecting beyond periphery of sprockets and ends of lugs.

12205 JOINTERS

1. Knives

1. Only sharp and evenly balanced knives should be used in a jointer cutting head.
2. The knives must not be set to take too heavy a cut, as a kickback is almost certain to result, especially if there is a knot or change of grain in the stock.
3. The knives must be securely fastened after the machine has been standing in a cold building over the weekend.

2. Push Block. When pieces shorter than 18 inches are machined, a push block should be used.

3. Point of Operation. Each hand-fed planer and jointer with horizontal head shall be equipped with a cylindrical cutting head, the throat of which shall not exceed $\frac{7}{16}$ inch in depth nor $\frac{5}{8}$ inch in width. It is strongly recommended that no cylinder be used in which the throat exceeds $\frac{3}{8}$ inch in depth or $\frac{1}{2}$ inch in width.

4. Automatic Guards. Each hand-fed jointer with a horizontal cutting head shall have an automatic guard which will cover all the section of the head on the working side of the fence or gage. The guard shall automatically adjust horizontally for edge jointing and vertically for surface work, and shall remain in contact with the material at all times.

5. Horizontal Head Jointer. Each hand-fed jointer with horizontal cutting head shall have a guard which will cover the section of the head back of the gage or fence.

6. Vertical Head Jointers. Each wood jointer with vertical head shall have either an exhaust hood or other guard so arranged as to enclose completely the revolving head, except a slot of such width as may be necessary and convenient for the application of the material to be jointed.

12206 PLANING, MOLDING, STICKING, MATCHING MACHINES, AND PROFILE AND SWING HEAD LATHES

1. Guarding of Cutting Heads. Each planing, molding, sticking, and matching machine, and profile and swing head lathe, shall have all cutting heads, and saws if used, covered by a metal guard. If such guard is constructed of sheet metal, the material used shall not be less than $\frac{1}{16}$ inch in thickness; and if cast iron is used, it shall be not less than $\frac{3}{16}$ inch in thickness.

2. Exhaust Hoods. Where an exhaust system is used, the guards shall form part or all of the exhaust hood and shall be constructed of metal of a thickness not less than the above.

3. Feed Rolls. Feed rolls shall be guarded by hood or a semicylindrical guard to prevent the hands of the operator from coming in contact with the in-running rolls at any point. The guard shall be fastened to the frame carrying

the rolls so as to remain in adjustment for any thickness of the stock.

4. Sectional Feed Rolls. Sectional feed rolls shall be provided for planers. Where solid feed rolls are used, the sectional finger devices shall be used to prevent kickbacks.

12207 HAND PLANES AND DRAW KNIVES

1. Choice of Tool. Care shall be used in selecting the correct plane or draw knife for the work to be done.

2. Firmly Clamped. Wherever possible, the work shall be held firmly in a clamp or vise.

3. Depth of Cut. The plane blade shall be properly adjusted, as too deep a cut will cause the plane to buck and clog.

4. Firmly Grasped. The plane or draw knife shall be grasped with both hands.

5. Bracing with Knees Prohibited. No one shall use a draw knife while using the knees to brace the material.

6. Protecting Blade. To avoid possible injury to the hands when reaching for other tools, planes and draw knives shall be put away in such a manner that the blades will be protected.

12208 BORING AND MORTISING MACHINES

1. Chucks. Safety-bit chucks with no projecting set-screws shall be used.

2. Boring Bits. Boring bits shall be provided with a guard that will enclose all portions of the bit and chuck above the material being worked.

3. Chain Mortiser. The top of the cutting chain and driving mechanism shall be enclosed.

4. Counterweights. If there is a counterweight, one of the following, or equivalent means, shall be used to prevent its dropping:

1. it shall be bolted to the bar by means of a bolt passing through both bar and counterweight;
2. a bolt shall be put through the extreme end of the bar;
3. where the counterweight does not encircle the bar, a safety chain shall be attached to it;
4. other types of counterweights shall be suspended by chain or wire rope and shall travel in a pipe or other suitable enclosure wherever they might fall and cause injury.

5. Universal Joints. Universal joints on spindles of boring machines shall be completely enclosed to prevent injury to operator.

6. Guarding Operating Treadles. All operating treadles shall be covered by an inverted U-shaped metal guard, fastened to the floor, of adequate size to prevent accidental tripping.

12209 SANDING MACHINES

1. General

a. INSPECTION. All sanders shall be carefully inspected before use. Sanding disks on belts shall not be used if they are frayed or cracked.

b. PERSONNEL PROTECTION

1. Goggles and masks shall be used during the sanding operations and while cleaning up afterward.

2. The hands or other parts of the body shall be kept from coming into contact with the abrasive surface of the sander.

c. GRASPING SANDER FIRMLY. Sanders are to be grasped with both hands and held firmly against the work. Care shall be taken that the sander does not break away, thereby causing injury or damage.

d. DISCONNECTING. The electric plug shall be pulled before sanding belts or disks are changed or before repairs or adjustments are made to the sander.

5. Belt Sanding Machines. Each belt sanding machine shall have both pulleys enclosed in such manner as to guard the points where the sanding belt runs onto the pulleys. The unused run of the sanding belt shall be enclosed.

Belt type sanders shall be adjusted to the proper tension.

12210 COMBINATION OR UNIVERSAL WOODWORKING MACHINES

1. Guards. For combination or universal woodworking machines, each point of operation of any tool shall be guarded as required for such tool in a separate machine. Such machines shall be provided with a separate starting and stopping device for each point of operation.

2. Feed Rolls. Feed rolls of self-feed sanding machines shall be protected with a semicylindrical guard to prevent the hands of the operator from coming in contact with the in-running rolls at any point. The guard shall be constructed

ted of heavy material, preferably metal, and firmly secured to the frame carrying the rolls so as to remain in adjustment for any thickness of stock. The bottom of the guard shall come down to within $\frac{3}{8}$ inch of a plane formed by the bottom or contact face of the feed roll where it touches the stock.

3. Drum Sanding Machines. Each drum sanding machine in a location where an exhaust system is required shall have an exhaust hood. If no exhaust system is required, another guard

shall be used. Guards shall be so arranged as to enclose the revolving drum. However, in cases where the use of a table makes complete enclosure impracticable, the guard should be arranged so as to enclose as much of the disk as possible and still leave room for manipulation of the material to be finished.

4. Disk Sanding Machines. Each disk sanding machine shall also have an exhaust hood or other guard which shall be arranged as described above.

Subsection B

SAWMILLS

12221 HOUSEKEEPING

1. Tripping Hazard. Good housekeeping around a sawmill is very important. Many a man has tripped over the crop end of a board and has fallen into a saw.

2. Clear Area. Before starting to chop or saw a tree, workmen shall clear a working area around it and a path so that they can get away from the tree quickly when it begins to fall.

12222 PERSONNEL PROTECTION

1. Sawmill Machinery. Loose clothing shall not be worn around a saw or any other piece of machinery at the sawmill. Gloves should *not* be worn while operating machinery.

2. When Handling Lumber. Workmen handling lumber shall wear heavy aprons, and leather gloves or other suitable hand protection.

3. Goggles. Goggles shall be worn while doing work where dust or flying chips are a hazard to the eyes.

4. Footwear. All workmen handling wood blocks, boards, bundles of shingles, etc., should wear safety toe shoes or other protective footwear.

5. Hard Hats. Workmen required to work under crane or monorail tracks, or where materials stored overhead create a hazard, shall wear protective hard hats while so employed.

6. Carrying Cases. Sharp tools shall be transported in carrying cases, or with sheathes installed over the cutting edges.

12223 SAFE OPERATING PROCEDURES

1. Protection of Hands. When operating power saws, the hands should always be kept out of the line of saw travel.

2. During Stormy Weather. Work shall not be carried on out-of-doors during periods of high wind and storms of sufficient violence to endanger workmen, except in case of emergency.

3. Attaching Dogs. When attaching dogs to logs, care shall be taken not to place the hand or fingers where they might be caught between the log and the dog.

4. Risk of Falling Lumber. Workmen shall not stand under lumber which is being moved.

5. Kickback. Workmen operating power feeds or other machines subject to kickback hazards shall not stand in line with the stock being fed into machine unless it is equipped with positive means of preventing kickbacks.

6. Portable Chain Saws. Workmen other than operators shall keep as far away as possible from portable chain saws when those machines are operating.

7. Riding Sorting Chains. Workmen shall not ride moving sorting chains or similar equipment, except where that is necessary in the operation of grading, tallying, or straightening lumber.

8. Crossing Sorting Chains. Only those workmen who work on sorting chains shall cross over those chains, unless elevator crossovers have been installed for their safety and convenience, in which case they shall use these crossovers.

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United States Navy
SAFETY PRECAUTIONS

Chapter 13
METAL WORKING

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Subsection A
THE SHOP

13101 SCOPE

The safe practices described in this chapter are applicable to all types of power-driven tools and should be used by all machine operators to avoid accidents involving themselves and other personnel. If there is any doubt about a safe procedure, the supervisor shall be consulted.

13102 HOUSEKEEPING

1. Areas around machines should be kept clear of obstructions and in nonslippery condition. All spilled oil or grease shall be cleaned up immediately.
2. Employees must keep their machines clean.
3. Do not clean chips from the surface of machines with compressed air or with hands. A brush or hook should be used.
4. When using portable electric equipment around machine tools, keep all electrical cords clear of moving parts.
5. Cleaning of one's clothes with compressed air is prohibited.
6. Do not place hand tools on lathes or other machines. Keep them in their assigned location. There are certain areas

on some lathes and machines which are useful for laying hand tools, as well as wooden platforms especially built to fit across the ways of the lathes, which may be used for hand tools.

13103 PROTECTIVE CLOTHING

1. Loose, flowing, or torn clothing, gloves, neckties, long sleeves, and rings or bracelets shall not be worn around machinery. Snug-fitting clothing shall be worn.
2. Goggles or face shields shall be worn when grinding or when there is danger of flying particles.
3. Gloves are *not* to be worn around rotating machinery unless sharp or rough materials are being handled. If gloves are worn because of sharp material, great care should be exercised to prevent their being caught in the machinery.
4. If clothing becomes caught in a machine, the power shall be shut off immediately.

13104 MACHINE GUARDS

1. All guards on saws, drill presses, and machines are to be properly adjusted and in working order before starting the machine.

2. Make sure that all gear and belt guards are in place before machine is operated.
3. Machine guards must be kept in position at all times unless removal is authorized for repairs or cleaning.

13105 PRELIMINARY PRECAUTIONS

1. Do not attempt to operate a machine with which you are not familiar.
2. Do not start any machine unless you are absolutely sure of its operation and that all is clear.
3. Do not start a band saw or saw of any type without first determining that the blade is in good condition and operating freely.
4. Unless conditions make it impractical, no employee should be permitted to operate electric or mechanical equipment or machines in a building or room when alone.
5. Before operating a machine make sure there is plenty of light to work by.
6. See that tools and work are properly clamped before starting the machine.
7. Switch and clutch of power equipment shall be located so that operator can control power without reaching across work.

13106 REPAIRING MACHINERY

1. All needed repairs shall be reported. Repairs, unless otherwise authorized by the supervisor, are to be made only by a repair mechanic.
2. Do not repair, oil, or clean machinery while it is in motion.
3. Shut off the power to machines during repairs or adjustment and attach a warning card to the switch. Lock switch with a padlock to insure that the machine will not be energized by other personnel.
4. Switches and valves, movement of which will endanger personnel working on lines and machinery, will first be locked by the man in charge of the work before permitting work thereon.
5. The power shall be shut off when changing such machine parts as face plates or chucks on lathes.
6. Block up ram and cut switches on power

hammers, punches, and presses when it becomes necessary to place any part of the body underneath it.

7. Replace machine guards after repairing, oiling or greasing, or after inspections have been completed and before the machine is started.
8. All tools used in making repairs or adjustments shall be removed so that all working parts of the machine will be free to move without damage. Care shall be taken that no one is in a position to be injured when the machine is again set in motion.

13107 OPERATING PRECAUTIONS

1. Do not attempt to adjust a tool or feel of the cutting edge while the machine is in motion.
2. Moving belts shall not be shifted except with a belt pole or suitable stick. Do not use hands or feet to shift belts.
3. Never apply a wrench to revolving work or parts.
4. Do not use steel hammers to knock cutters into position.
5. Do not use hands or body to stop moving parts, even when the power is shut off.
6. Never lean against a machine that is running.
7. Never leave moving machinery unattended.
8. Do not distract the attention of a machine operator.
9. Excessive cutting speeds, feeds, and depth of cut should be avoided.
10. Never toss or throw an object at another employee.
11. Walk; do not run.

13108 WIRING

1. **Insulation.** Do not use electrical equipment or machines with frayed or otherwise deteriorated insulation.
2. **Grounding.** Electrically driven portable machinery as well as fixed electrical equipment shall have the frame grounded.
3. **Method of Grounding.** On shipboard, electrically driven portable hand tools shall not be operated without a ground wire connection

between the metal housing of the tool and the steel structure of the ship. If the tool is equipped with a grounded plug, be sure that the ground wire is properly connected to the tool housing and the plug. The grounded plug should be carefully inserted (not forced) into the grounded receptacle, with groove and polarity pin in proper alignment. If the tool is equipped with a two-contact plug and a supplementary ground wire, be sure that the ground wire is securely attached to the ship's structure by a clean, metal contact. For method of determining that the ground wire is safely connected and that the portable tool, cord, and plug are safe to use, see detailed in-

structions and tests in *Bureau of Ships Manual*, chapter 60, section II. Where the ground wire is independent of the tool plug, the ground wire should always be connected *before* the plug is inserted in the receptacle and should not be disconnected until *after* the plug is pulled out. Where portable tools are provided with grounded plugs, this sequence of connecting the ground first and disconnecting it last is automatically provided in the arrangement of the contacts in the grounded plug and grounded receptacle. It is, therefore, in the interest of safety and convenience to install these grounded plugs on all portable tools.

Subsection B

SPECIAL MACHINERY

13121 LATHES

1. **Dangers.** The principal sources of injury to lathe operators are: projections on face plates and chucks; projecting set screws in lathe dogs; projections on the work; chips; cutting fluid; handling heavy chucks or stock; and rotating stock projecting from turret lathes and automatic screw machines.

2. **Shields and Guards.** Face plates and chucks should have no projections; or circular shields should be installed to prevent accidental contact with projections. Safety type lathe dogs, with no projecting set screws should be used. Chip guards, particularly on high speed operations, are recommended. Splash guards should be provided to protect the operator and the working area from cutting or cooling fluids thrown from the work. Pipe guards or other enclosures should be installed to prevent injury from stock projecting from turret lathes or automatic screw machines.

3. **Protruding Tail Stock.** Completely cover all tail stock protruding from the end of a machine lathe when the machine is in operation.

4. **Filing.** When filing close to chuck or dog, always file left-handed. Never use a file with an unprotected tang. Use a file handle.

5. **Installing Chucks.** Chucks or face plates on lathes shall be installed by hand power only.

The power which drives the machine shall never be used for this purpose.

6. **Handling Chucks.** Mechanical lifting devices should be provided for handling heavy chucks.

13122 MILLING MACHINES

1. **Dangers.** The chief hazards of the milling machine are created by the rotating cutter and flying chips.

2. **Guards.** A transparent shield over the cutter will prevent accidental contact with the cutter and serve also as a chip guard. Guards may be adjustable.

3. **Control Buttons.** Control buttons and levers should be readily accessible to the operator. Hands shall be kept away from work when machine is running.

4. **Clamping Work.** The cutter and arbor shall be secure. The work shall be clamped securely before the machine is started.

13123 SHAPERS AND PLANERS

1. **Railings.** To minimize the hazard created by the movement of the carriage or table, railings extending beyond the farthest point of travel should be installed.

2. **Wire Guard.** Where practicable, a readily detachable chip guard of heavy wire mesh should be placed over the cutting tools.

3. **Openings in Planer Bed.** All openings in

shaper and planer beds should be filled solidly or completely covered.

4. **Goggles.** The operator shall wear goggles and stand out of the line of flying chips.

5. **Loosening Tool Holders.** When tool holders are being loosened, the tool shall be held with one hand or a support placed under it.

6. **Adjusting Bed Stroke.** The planer shall be idle when the length of the bed stroke is being adjusted. No one shall ride the bed at any time. Tools of any kind shall not be left under the bed.

7. **Removing Chips.** A brush—never hands—shall be used to remove chips; chips shall be kept off the ways, floor, and bed of planer.

13124 DRILL PRESSES

1. **Dangers.** Most drill press injuries result from projection on the spindle, insecurely clamped work, accidental contact with the drill, or the breaking of the drill.

2. **Enclosing Spindle.** The spindle should be enclosed as completely as possible, and where the job will permit, a telescope guard placed over the drill is advisable. Counterweight chains should be maintained in good condition.

3. **The Drill.** Only straight, undamaged drills, properly sharpened to cut to the right size, shall be used.

4. **The Chuck.** The chuck shall be tightened securely with the key provided. The key shall not be left in the chuck. Common wrenches or pliers shall not be used on any chuck.

5. **Clamping Work.** The work shall be firmly clamped and a center punch used to score the material before the drilling operation is started. If the work should slip from the clamp, no attempt shall be made to stop it with the hands. The machine shall be stopped while making any adjustments or repairs.

6. Personnel Protection

1. Snug-fitting clothing shall be worn.

2. A cap shall be worn if the operator's hair is long.

3. Gloves shall not be worn while the drill is in operation. If rough material is being worked on, gloves may be used but only while handling material.

4. No one shall reach around a revolving drill.

5. Hands shall never be put under the ram.

6. No one shall pull tripping rods or tamper with safety devices.

7. **Special Tools.** Attachments and special tools provided for the feeding or removal of parts shall be used.

13125 BORING MILLS

The revolving table of a vertical mill should be protected by a sheet metal or pipe-rail guard. The guard should be hinged to permit convenient access for the setting up and adjustment of the job. Work should be securely clamped to the table and no measurement or adjustment should be attempted while the machine is in motion.

13126 METAL SAWS, GENERAL

1. Protection of Personnel

a. **AUTHORIZED PERSONNEL.** Only authorized employees who are qualified to do so shall operate saws.

b. **FACE.** Goggles or face shields shall be worn while using the power saw and while cleaning up afterward.

c. **HANDS.** When thick material is to be sawed, the hands shall be placed to the side and to the rear of the material, out of line of travel of the saw.

d. **REACHING.** No one shall reach over a saw to get finished material.

2. **Inspection of Blade.** The blade shall be inspected at frequent intervals and always after it has locked, pinched, or burned. The power shall be shut off and steps taken to ensure its not being turned on again until necessary repairs or adjustments have been made.

3. **Small Pieces.** In machining small pieces, a stick with a notch cut in it shall be used to push the pieces through the saw.

4. **Long Material.** When long material is to be sawed, the end shall be supported by a rack, table, or by a fellow employee.

5. **Overloading Motor.** The saw motor shall not be overloaded by pushing too hard or cutting stock that is too heavy.

13127 CIRCULAR SAWS

1. **Hood.** Circular saws should be equipped with a hood guard which automatically adjusts itself to the thickness of the stock being cut. When tube or bar stock is being cut, the sliding stock guide should be used.

2. **Disposal of Scrap.** The part of the saw under the table should be guarded with a complete enclosure which provides for the disposal of scrap metal.

3. **Saw Tables.** Saw tables shall be firmly secured to the deck or floor.

4. **Flying Particles.** A transparent guard placed in front of and over the saw will provide protection against flying particles of metal.

5. **Exposed Blade.** The segment of blade exposed at any time should not be more than $\frac{3}{8}$ inch greater than the thickness of the stock being cut.

13128 BAND SAWS

1. **Enclosed Wheels.** The band saw should have upper and lower wheels completely enclosed with sheet metal or heavy small-mesh screen. The portion of the saw blade between the upper saw guide and the saw table should be completely enclosed with a sliding fixture attached to the guide.

2. **Access Doors.** Access doors equipped with latches should be provided for changing blades.

3. **Crowding.** Do not crowd or twist a band saw or stand immediately in front of the cut.

4. **Brazed Joints.** To avoid vibration, brazed or welded joints shall be the same thickness as the saw blades.

13129 SHEET METAL WORK

1. **Squaring Shears.** When shears are located in congested areas it may be advisable to erect railings on the exposed sides and at the rear of the machine. Treadles on squaring shears shall be guarded throughout their entire length by fixed guards which leave only sufficient room between guard and treadle for the operator's foot.

2. **Alligator Shears.** Where practicable the moving jaw of an alligator shear shall be

enclosed in a heavy mesh guard. The guard can be adjustable for different thicknesses of material. In addition and where practicable, a barrier guard shall be installed in front of the knife. The lower edge of the guard should be low enough to prevent placing the fingers under the knife. A hold-down bar should be provided for use with heavy stock. In crowded areas guard rails should be installed.

3. **Beaders.** Large sheets of metal shall be supported while being beaded.

4. Hand Brakes and Hand Shears

1. The metal to be shaped and the hand brake shall be cleaned thoroughly before the operation is started.

2. When beating out the bend in the material, care shall be taken that the hammer does not glance off and cause injury.

3. Care shall be taken while using the shears that the hand is not jammed or pinched.

4. Large sheets of metal shall be supported while being worked on.

5. Rough edges and burrs left on the material after cutting shall be removed.

13130 RUBBER MAKING MACHINERY

Rolls which require a feed opening large enough to admit large masses of rubber cannot be guarded with a barrier with an opening small enough to keep the hands out. Therefore, the inrunning side of the calender rolls shall be equipped with horizontal safety trip rods or cables across the front and back faces of the rolls, and vertical tight wire cables near each end of the front and back faces of the rolls. Such safety stops shall be located so that contacts with the body or head of the operator will instantly actuate the stopping mechanism and quickly stop the rolls.

13131 FORMING ROLLS

1. **Guard.** A barrier guard should be placed in front of the intake to give protection against operators being drawn into the forming rolls.

2. **Clearance.** When operating conditions permit, the distance between the guard and the nip joint should not be more than three-eighths of an inch.

13132 BUFFERS AND ABRASIVE GRINDING WHEELS, GENERAL

1. Inspection. Buffing wheels or disks shall be inspected before being used. The ring test shall be made on grinding wheels to insure that wheel is not cracked. Wire buffers that are badly worn, frayed, or that are becoming loose at the hub shall be discarded. Fabric buffers that are frayed or pitted or worn out of round shall be discarded.

2. Personnel Protection

a. SHIELDING FACE. A shield shall be kept in place between eyes and work at all times while buffing and grinding; either goggles or face shield shall be worn by the operator.

b. STANDING ASIDE. The operator shall stand to one side of the wheel when first applying power.

c. PROTECTION OF HANDS. Care shall be taken that the hand is not drawn into contact with the buffing and grinding wheels.

d. END GUARDS. All grinders shall be equipped with end guards.

3. Machine Specifications and Use

a. GUARDS. A guard shall always be used on buffing and grinding wheels.

b. CLEANING. The bearing surfaces of the wheels, flanges, and spindle shall be cleaned so that the clamping pressure will be evenly distributed.

c. SIZE OF BUSHING. The hole in the buffer or grinding wheel shall be the proper size for the spindle (neither too small nor too large).

d. SPEED. The speed of the spindle shall not run beyond rated speed for the type and size of the buffer or grinding wheel used, nor in excess of manufacturer's specifications.

e. FLANGES. Flanges that are recessed and large enough to clamp the wheel well out toward its perimeter shall be used.

f. WASHERS. Compression washers as large as the flanges shall be used between the flanges and the buffer or grinder. If rubber, use washers 0.125 inch thick; if blotting paper, 0.025 inch thick.

g. TIGHTENING NUTS. Spindle and nuts shall be tightened just enough to keep the buffer or grinding wheel from moving out of position between the flanges.

h. ALIGNING BUFFER. Before the power is

turned on, a check shall be made to ascertain that the buffer or wheel runs true and will not strike or rub against any object.

i. REFERENCE. For more details on the care and use of abrasive wheels, see American Standards Association Safety Code, B 7.1-1947.

13133 OPERATING GRINDING WHEELS

1. Position of Hood. Every grinding wheel shall be enclosed in a hood. Tool or work rests shall be mounted on firm supports and be spaced not more than one-eighth of an inch from the surface of the wheel.

2. Clearance. The hood shall be constructed so that the peripheral member can be adjusted to the constantly decreasing diameter of the wheel by means of an adjustable tongue or equivalent. The distance between the wheel periphery and the tongue or end of the periphery band shall be maintained at approximately one-eighth of an inch.

3. Angle of Hood. The upper point of opening in the retaining hood facing the operator shall not be less than 25° nor more than 65° from a vertical line drawn through the spindle center.

4. Swing Frame Machines. The maximum exposure of the wheel periphery or circumference for retaining hood on swing frame grinding machines shall not exceed 180° and the top half of the wheel shall be protected at all times.

5. Stationary Wheels. The maximum exposure of the wheel periphery or circumference on bench or floor stands shall not exceed 90°.

6. Guards

a. PROPERLY ADJUSTED. Stationary grinding wheels are never to be operated unless protective guards are in their place and the tool rest is correctly adjusted.

b. REPLACING WITH SCREEN. Portable pneumatic or electric grinding machines using wheels and wire brushes should never be operated without a guard unless shape of job necessitates removal of guard. In this case suitable screens are to be placed around entire job and operators are to wear full protective equipment.

7. Good Condition. Do not use a grinding wheel with a glazed or dull surface or one that is out of balance.

Section 2

FOUNDRIES

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13201 HEALTH REQUIREMENTS

1. **New Employees.** New employees should be given a thorough physical examination before starting on a job. Any deficiencies noted should be called to the attention of the supervisor so that suitable work assignments can be made.

2. **Examinations.** All employees engaged in foundry work should be periodically examined in accordance with regulations in NCPI 88.9-2.

13202 HOUSEKEEPING

1. **Aisles.** Provide adequate aisles and keep them clear.

2. **Safe Piles.** Material shall be placed in safe piles in the scrap yard and shop, in order to reduce the possibility of lifting injuries.

13203 SCRAP YARDS

1. **Personal Protective Equipment.** Workers in scrap yards shall be provided with the following protective equipment:

1. safety spectacles equipped with side shields;
2. serviceable type safety shoes or metal foot guards or toe clips;
3. leather gloves, preferably with steel studs;
4. protective hats;
5. foul weather gear;
6. safety belts and lifelines for use inside gondola cars to prevent falling through when hopper doors are opened.

2. **Operating Precautions**

a. **HOOKING MATERIAL.** Workers shall be advised on proper method of lifting and hooking up of material.

b. **AUTHORIZED PERSONNEL.** Only authorized and designated men shall operate a crane.

c. **HAND SIGNALS.** They shall be advised as to the standard hand signals for crane operation.

d. **SAFETY TOOLS.** Safety wrenches shall be used for opening hopper doors. Safety car movers shall be used instead of pinch bars.

e. **LOOSE MATERIAL.** Piles of sand, clay, or other loose material shall not be undermined.

f. **PORTABLE BELT CONVEYORS.** Operators of portable belt conveyors shall be given full instructions. Other employees shall not be permitted to operate such equipment.

g. **SUSPENDED LOADS.** Employees shall not stand under suspended loads. Magnet cranes are especially dangerous. In no case should cranemen carry suspended loads over employees.

13204 SAND MILLS, CUTTERS, AND SIFTERS (SCREENS)

1. **Safety Apparel.** Operators shall wear safety spectacles with side shields, safety shoes, and close fitting work clothes.

2. **Inspection.** Persons in charge shall see that all moving or revolving parts and projecting set screws on machines are guarded and the machine is electrically grounded, and interlocking devices in proper working condition.

3. **Tagging Switches.** Repairmen shall tag and lock all switches before starting any repairs on machines.

4. **Sand Samples.** A sheet metal cone attached to a stick shall be used at all times for taking sand samples.

5. **Shoveling Sand.** Sand shall not be shoveled out of mills while they are running.

13205 MOLDING AND CORE MAKING

1. **Safety Shoes.** Congress-type safety shoes shall be worn by all personnel.

2. **Protection of Hands and Feet.** Keep feet and hands from under flasks and core boxes.

3. **Screening Sand.** Sand shall be properly screened or magnetically separated to remove nails and other sharp metal.

4. **Gagger Rods and Tools.** Molders and core makers must work with care in handling gagger rods and core wire. Hand tools used for this purpose must be kept in good condition. Each molder shall have a box in which to keep gagger irons, nails, and clamps.

5. **Bracing Cores.** Careful bracing of cores is necessary in large molds as heavy cores may topple over.

6. **Suspended Molds.** Work must never be done underneath molds that are suspended from cranes. Molds must be placed on tripod supports or substantial horses.

7. **Venting Molds.** Molds shall be carefully vented and rammed to prevent explosions.

8. **Lighting Oil Burners.** In lighting oil burners of annealing furnaces and core ovens, the following rules shall be observed:

1. Make sure air or steam valve is closed.
2. Apply lighted torch at fuel inlet.
3. Open oil valve slightly.
4. Turn on air or steam.

9. **Lighting Gas Burners.** In lighting gas burners of annealing furnaces and core ovens, the following rules shall be observed:

1. Be sure doors are open wide.
2. Make sure all gas is shut off from furnace and that draft damper is open.
3. Apply lighted torch at gas inlet.
4. Turn on gas.

10. **Floors and Aisles.** Employees must know the importance of keeping molding floor clean, and must see that adequate gangways and aisle space are provided to permit access to molds by those carrying ladles.

11. **Spattering.** Sand shall be poured on concrete pavements around pouring floors to reduce spattering of hot metal in case of a spill.

12. **Water on Floor.** Pools of water must not be left on pouring floor. Molten metal will spatter widely if dropped in water.

13. **Cleaning Molds.** Eye protection must be worn when using air in cleaning off molds.

13206 CUPOLAS AND FURNACES

1. **Back Draft.** Gas masks shall be available near the charging area of cupolas in case of high winds creating a back draft.

2. **Personal Protection.** When necessary to work inside a cupola, a circular screen must be suspended inside the cupola to protect the men from falling objects. Protective hats, safety shoes, and goggles shall be worn for this work.

3. **Warning Signs.** Warning signs or cross-bars shall be placed at charging doors to indicate that men are working in the cupola.

4. **Loitering.** Men shall not sleep or loiter under the charging platforms because of the danger of objects falling from platform and the danger of escaping carbon monoxide.

5. **Eye Protection.** Safety goggles shall be worn at all times by furnace men. Special colored glasses shall be worn when looking into furnace.

6. **Tapping Out.** Tapping out requires skill and shall be done by experienced men only. The correct method is to bring the bott up immediately over the stream of metal close to the hole at a sharp angle to prevent spattering. An extra supply of botts must be kept on hand.

7. **Tapping Bar.** The back end of the tapping bar shall never be held above the level of the hole, as the bar may puncture the sand bed and cause a run-out through the bottom.

8. **Cleaning Methods.** When cleaning up refuse from behind furnaces, men must look out for persons passing below.

13207 CRUCIBLES

1. Graphite crucibles, consisting of graphite, plumbago, or black lead, shall be used instead of clay, because they withstand higher temperatures and are not so apt to break.

2. Old, worn-out crucibles shall not be ground up for use in manufacturing new crucibles.

3. Extra crucibles that have been used before shall be kept on hand as standbys in case they are needed on short notice.

4. All employees shall be fully instructed on how to handle crucibles to avoid breakage.
5. New crucibles should be bought in excess of actual requirements and stored to allow them to "season". Marking date of manufacture will assist in selecting the older ones first.
6. A number shall be assigned to each crucible and a tally kept of the number of heats taken.
7. Upon receipt, new crucibles shall be examined for cracks and flaws, not only by the eye, but by tapping with a light hammer.

13208 MOISTURE IN CRUCIBLES

1. New crucibles that have become wet must be stored in a place where they will dry out thoroughly for four or five weeks before using. The roof of a continuously operated core oven is a good place for the stowage chamber.
2. Crucibles contain less than one-fourth of one percent of moisture when they come from the kilns, but on cooling and afterwards, they absorb moisture from the air.
3. Crucibles must not be placed on a layer of damp sand or on a cold floor and left for any length of time for they absorb moisture if the temperature falls materially below 250°F.
4. To anneal a crucible properly, it must be slowly heated to somewhat above 250° F. and allowed to "soak" at this temperature long enough to remove all moisture. If thoroughly annealed, it may then be put into service.
5. Consideration should be given to the size of the crucible, as large ones take a longer "soaking" period to reduce the moisture. In drying out No. 200 crucible, 10 hours or more should be allowed for bringing it up to 250° F. and fully 10 hours more for "soaking."
6. If its dryness is doubtful a crucible must next be heated for some hours to a dull red heat and allowed to cool again, very slowly, to about 250° F. In any case, crucibles must be at 250° F. or over, when they go into the furnace.

13209 PREVENTING CRACKS IN CRUCIBLES

1. Crucibles must not be quickly subjected to high temperature if considerable moisture is present, as the walls may expand and cause ruptures or cracks. The same is true in natural contraction of the drying crucible.
2. Crucibles must be checked for small "pinholes" and "skelping" caused by rapid expansion or contraction. These defects are the chief causes of failure at a critical time during pouring or while crucible is being pulled from the furnace. It may rupture and spill metal on hands or feet.
3. When crucibles are heated with fuel containing too high a percentage of sulphur, or in oil furnaces using too little oil or too much steam, fine cracks (called alligator cracks) often cover the surface of the crucible.
4. Operators must thoroughly understand that when using an oil furnace, an excess of air or steam, or insufficient supply of oil, may cause an oxidizing action.
5. When crucibles are stored on top of furnaces, operators must be sure the furnace covers fit properly. Carelessness may cause moisture to be given off from the gases when fresh fuel is placed on the fire; the moisture is likely to come in contact with crucibles and cause alligator cracks.

13210 HANDLING CRUCIBLES WITH TONGS

1. Care must be used in handling crucibles with tongs and shanks. Where tilting furnaces are used, as many as 50 heats are possible from a crucible; but if crucibles have to be removed by tongs, they can be used on an average of only 15 heats.
2. Because a crucible is soft and plastic at white heat, it may be squeezed out of shape by the excess pressure of forcing the handles of the tongs together. This will gradually weaken the walls and eventually cause a complete rupture, with serious burns to operators.

3. There are three styles of tongs in general use—one pronged, two pronged, and spade tongs. Tongs must fit perfectly from the widest part of the crucible (usually called the "bilge" or "belly") down to within a few inches of the bottom. Tongs should not extend to the extreme bottom, because of the difficulty in placing the crucible in the shank.
4. Proper use of tongs consists in holding the crucible below the bilge and lifting it so that the least possible pressure is exerted on the crucible walls.
5. One pronged tongs should be used for small crucibles, up to size No. 40. Never use one pronged tongs for large crucibles ranging from No. 200 to No. 300 because the pressure is exerted only at the bottom, which means a single point of contact.
6. At least two pairs of tongs shall be provided for each size crucible; one pair may become badly bent or worn.
7. Melters must never drive down the ring of the tongs by using a skimmer or other tool. This practice will cause cracks.
8. Never use improperly fitted tongs. It is important to see that tongs fit the crucible to prevent spillage of metal.
9. Never alter two pronged tongs by cutting off the lower prong even if there is a lack of space in the furnace.
10. A set of cast iron forms shall be used to restore tongs to their proper shape. To restore the tongs to their original form it is only necessary to put them in the furnace, raise them to a red heat, clamp them to the proper iron form, and bring them back into shape by means of a heavy hammer.
11. Crucibles and tongs must be kept free of clinkers, coal, or coke, to prevent forcing foreign material into sides of crucibles when grasped by tongs.
12. The bottom surface (outside) of a crucible must be free of any foreign material to prevent uneven distribution of weight and concentration on projecting spots.

13211 METAL IN CRUCIBLES

1. Ingots must not be thrown into the crucibles in haste as this may cause dents in the sides or bottoms that can eventually develop into cracks or fissures.
2. Ingots must not be crammed into crucibles, because of the danger due to expansion of the metal while heating, which can cause cracks to form.
3. Care must be taken to see that all molten metal is poured from crucible because the cooling of the residual mass will create a strain on the crucible.

13212 CLEANING AND FINISHING ROOMS

1. **Moving Castings.** Castings must not be moved through the foundry by magnetic crane.

a. **STEEL CASTINGS.** Workmen shall be instructed as to the proper method of attaching slings or chains on the heads or risers of steel castings.

b. **IRON CASTINGS.** Slings or hooks shall not be attached to the heads of iron castings.

2. **Inspection.** A thorough inspection of casting containers, slings, and hooks shall be made at regular periods.

3. **Crane Signals.** A standard set of signals shall be used to guide the crane operator. Signals shall be given by one man only.

4. **Flogging Floor.** All men working on roughing or flogging floor must wear eye protection and safety shoes. Shields must be placed between workmen to stop flying chips and nails.

5. **Sand Removal.** When removing heads and risers by cold-cutting saws, all sand shall be removed from the casting before placing it on the saw table.

6. **Chipping.** Chippers shall be sure to use good chisels and hammers, and to wear eye protection. Chipping should not be done in the open; that is, some method of screening should be provided to prevent flying particles from striking personnel in the area.

7. **Annealer Pits.** Chainmen entering large annealer pits shall wear safety belts with lifelines, and wooden-soled safety-toe shoes.

8. **Welding.** Gas or electric welding must be done in a segregated area with shields around work to prevent other persons from

coming in contact with the injurious rays. Operators shall be equipped with burners' safety goggles for gas welding, and electric welders should wear the approved hoods and in addition both shall wear leather aprons, leather gloves, spats, and safety shoes.

9. Hydraulic Presses. Where hydraulic presses are used for straightening steel castings, the press blocks should be grooved to prevent flying out. Operators should place a heavy wire screen between the press and themselves.

10. Hand Tools. When possible, all hand tools, including portable pneumatic or electrically driven tools should be returned to the tool room at the end of each day for inspection and for any necessary repairs.

11. Compressed Air. Compressed air shall never be blown towards anyone, used for cleaning of personal clothing, or used to cool a person off.

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FORGES

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13301 PERSONAL PROTECTIVE EQUIPMENT

1. All personnel in the forge shop shall wear safety shoes, leather aprons, and safety spectacles at all times. Other special personal protective equipment is prescribed in succeeding articles of this chapter.
2. Persons working at heating ovens shall wear the proper shade number glasses.

13302 TOOLS

1. Turn unsafe tools such as burred flatters, bevelers, shapers, etc., into the tool room for redressing.
2. To prevent tripping hazards, place all tools in proper racks provided to keep them off the floors.
3. Tongs, hammers, files, chisels, and shaping tools should be well dressed, have good handles, and be free from cracks.
4. Material should be adequately screened when doing any chipping by hand or with pneumatic tools.

13303 HAMMERS, SHEARS, PRESSES

1. **Inspection.** Before using hammer, shear, or press, make your own inspection to see that everything is in good order. If anything is wrong, tell your supervisor.

2. **Heating Die.** Never operate hammer when dies are cold. Always preheat dies by inserting hot bar, then closing dies. This method reduces the chances for cracking or breaking dies.

3. **Guards.** Never operate hammer without first adjusting scale guards to proper position.

4. **Changing Die.** In changing dies or making repairs always place a substantial safety prop under the hammer, shear, or punch. (See illustration, "Forging Hammer Safety Props".) In the case of steam or air hammers, be sure

the supply valve is tightly closed, and a warning sign placed on the valve.

5. **Repairing Equipment.** In all cases block the treadles to prevent accidental tripping while working on dies or hammers. When repairs have been completed, and before the power has been turned on, remove all tools and loose material. When shimming dies, always place key or steel bar on top of dies, allowing plenty of hand clearance in case the ram accidentally descends. When setting dies make sure that the keys do not project too far beyond the front of ram, as they might cause injury.

6. **Stopping Hammer.** At the end of the shift or when steam hammer is not running, always leave the ram resting on the bottom, to prevent accidental tripping or injury to persons passing nearby.

7. **Blowing Lines.** Before adjusting scale-blowing lines (either air or steam), be sure hammer is not in motion, and that ram is properly blocked up.

8. **Swabbing Dies.** In swabbing dies, use swabs which are long enough so the hands do not get under the dies.

9. **Treadle and Fly Wheel.** Keep all stock, flash, and other material away from treadle mechanism and flywheel guards.

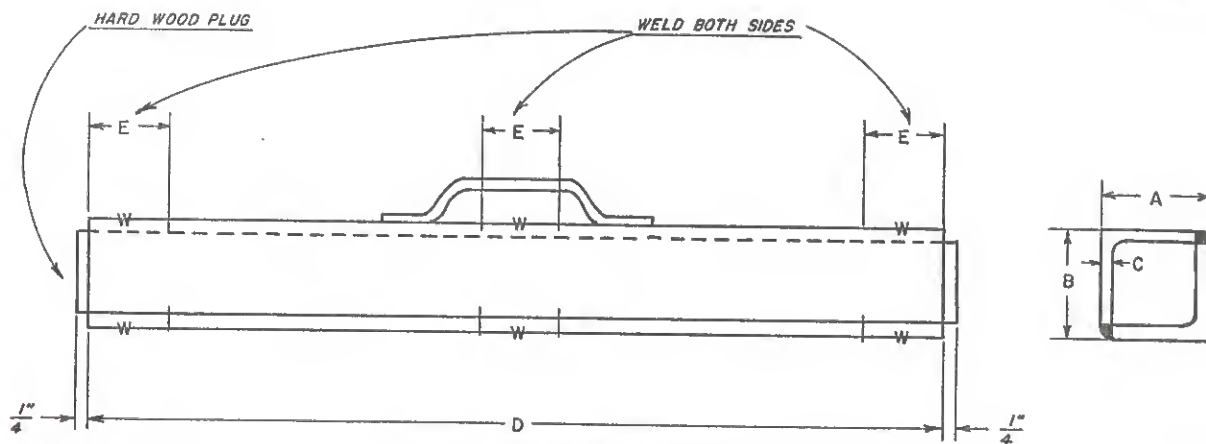
10. **Clogged Die.** If material sticks in the die, it shall be removed with a stick or a soft metal tool, or it shall be reported to the supervisor.

11. Dangerous Acts

1. Never put head or hands between dies unless dies are positively blocked up, power shut off, and a warning sign attached to supply valve, switch, or starting lever.

2. Avoid stepping on hot flash.

3. Avoid standing in front of operating hammers unless it is a part of your job.



FORGING HAMMER SAFETY PROPS

MATERIAL—ANGLE IRON

HAMMER SIZE	A	B	C	D	E	ACTUAL LOAD ON COLUMN	COLLAPSING LOAD ON COLUMN	PRESENT FACTOR OF SAFETY
2000.....	1¾	1¾	¼	35	6	2400	57500	23.9
3000.....	1¾	1¾	¼	40	6	3870	50146	12.95
5000.....	2	2	3/8	40	8	6080	50146	8.46
8000.....	2	2	3/8	45	8	10600	80200	7.57
12000.....	2½	2½	3/8	48	10	15000	122500	8.15
20000.....	2½	2½	3/8	48	10	24000	122500	5.15
25000.....	2½	2½	3/8	48	10	30000	122500	4.15

Note: Collapsing load determined by using Rankine's formula for short columns.

- Never stand in front of hammers while they are being propped.
- When operating shears, never put fingers between gages and shears.
- Always wear safety spectacles and safety shoes on drop forge and hammer work.

13304 FURNACES—OIL OR GAS

1. **Lighting Furnace.** When lighting furnaces, first see that all furnace doors are open. Insert a burning piece of oily waste on a long rod into the furnace. Allow fuel to flow over the waste and ignite. If air is used, turn it on slowly.

2. **Personal Protection.** Always wear safety spectacles or plastic eye shields when lighting furnaces and it is good practice to turn head away to avoid possible flash back. Also see that no one else is in a dangerous position.

3. **Relighting.** Before relighting furnaces shut off fuel, and wait long enough for gases to escape. In oil furnaces see that draft plates are properly adjusted.

13305 DIPPING MATERIAL

1. **Preheating.** Material, tools, baskets, etc. shall be preheated before being placed in hot oil, cyanide, lead, hardening or drawing salt, etc. in order to prevent an explosion.

2. **Fire Protection.** Oil shall not be allowed to collect on floor. In case of fire use a foamite extinguisher.

3. **Carburizing Compound.** Never leave fire burning over night in carburizing packing compound.

4. **Personal Protection.** Cover-all type eye protection similar to rubber acid goggles, as well as aprons and safety shoes, preferably high type shall be worn when dipping forgings.

13306 POTASSIUM CYANIDE AND SODIUM CYANIDE

1. **Dangers.** Case hardening compounds are deadly poison. Every possible precaution shall be taken to keep persons from getting the compound in their mouths or in breaks on the skin, or from breathing the vapors. Hardening compounds used as cyanide shall be kept in a locked cabinet, box, or drawer.

2. **Ventilation.** Adequate ventilation shall be provided for all personnel during exposure to cyanide hazards.

3. **Personal Protection.** Wear cover-all type eye protection similar to rubber frame goggles with ventilation when handling compounds. In addition, do not handle hardening compounds with bare hands; wear rubber gloves.

4. **Contamination of Food.** Food must never be stored, handled, or consumed in the vicinity of cyanide solutions.

5. **Smoking.** Smoking is prohibited while personnel are handling cyanides or when they are in the vicinity of cyanide solutions.

6. **Moisture and Acids.** Cyanide must be kept away from moisture and all acids.

7. **Containers.** Material shall be stored in locked airtight metal containers. Each container must be labeled as to contents and marked POISON.

8. **Opening Containers.** Cyanide containers shall not be opened except in the building or room where they are to be used. Unopened drums must remain in stores away from all acids.

9. **Stowing.** After removing the cover, cyanide shall be stowed in the original container until used, unless it is impractical to do so.

10. **Removing From Container.** When removing cyanide from a container, use a metal scoop and gloved hands, or dump the container as required.

11. **Breaking Fused Block.** Should cyanide be fused in a solid block in the container, crack it up into smaller pieces by hitting the container with a sledge hammer before opening. Never crack it with cover removed.

12. **Heat Treating Salts.** It is understood that "Perlition Liquid Heat" contains cyanide, and that other heat treating salts, identified by pink color, contain nitrates or nitrites. Attention is directed to the fact that cyanides and nitrates or nitrites react violently when heated together and a disastrous explosion may result. Accordingly, adequate precautions shall be taken to insure that "Perlition Liquid Heat" manufactured by E. F. Houghton Co., is not mixed with other heat treating salts.

13307 TUMBLING BARREL

1. **Cleaning.** A dust respirator, gloves, safety shoes, and dust-tight goggles shall be worn when cleaning out rust and dirt from tumblers.

2. **Wetting Down.** Wetting down of residue in tumbler will assist in preventing a dusty condition.

3. **Rust Disposal.** The rust, etc. shall be placed in a container and moved to outside area for disposal.

13308 CRANES

Only one person in each gang shall be assigned the responsibility of giving the signals to crane operators. Manually operated wall or jib cranes must be tended only by experienced personnel.

Section 4

METAL CLEANING AND COATING

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13401 PERSONNEL PROTECTION

1. Ventilation

a. **SPACE.** Spaces used for metal cleaning and coating shall be ventilated as well as possible by general room ventilation.

b. **MECHANICAL.** Mechanical ventilators shall be used with equipment such as cut-off saws, grinding wheels, and ovens.

c. **RESPIRATORS.** Respirators shall be used during operations when dust and fumes cannot be effectively removed.

2. **Painting Compounds.** Nonsilica type painting compounds shall be used.

3. Guards and Protective Devices

a. **FLYING PARTICLES.** Guards for protection of personnel against flying particles shall be placed around any casting, chipping, or cleaning operation.

b. **MOVING EQUIPMENT.** Guards shall be provided for moving machinery, electrical equipment, and other types of hazardous apparatus.

c. **MISCELLANEOUS.** Operations concerning tumbling mills, shakeout equipment, and cleaning and pickling shall be adequately guarded and suitably exhausted.

4. **Emergency Flood Showers.** Near any chemical, caustic, or alkali operation, showers shall be available for cleaning or washing injured parts of the body. Shower head and valve control shall be painted for maximum color contrast with background.

5. **Sand Blasting.** Sand blasters operating sand-blast equipment when there is any possibility of abrasive coming in contact with operator, shall wear abrasive cleaning helmet and safety shoes.

6. **Pneumatic Tools.** Pneumatic tools shall be equipped with devices to hold tools in the machine. No tool shall be pointed at another workman.

7. **Portable Grinders.** Portable or swing type grinders should not be used with the hoods removed. Grinder operators should wear eye protection, leather aprons, gloves, and safety shoes.

8. **Pickling Rooms.** Rubber-frame goggles, rubber gloves, and acid resisting safety footwear shall be worn by men in dipping and pickling rooms.

13402 EQUIPMENT

1. **Testing Equipment.** Due respect must be shown for such operating equipment as rotating test machines and machines exerting large forces. Equipment of this character shall be turned off before attempting to investigate possible faults or to inspect operating difficulties. A safe distance shall be maintained from hydraulic test equipment when operating under pressure. Personnel shall remain clear of the plane of rotating weights used during some test procedures.

2. **Resistance Welding.** Operators of this type of equipment shall consult or be thoroughly familiar with the manufacturer's instruction regarding correct and safe operating procedure. Approved personal protective equipment shall always be worn by operators when engaged in this work.

3. **Welding Equipment.** Welding torch and arc-welding equipment shall be handled with careful regard for the hazards involved. Matches shall not be used to light the torch, and the torch shall never be pointed at com-

bustible materials. See chapter 11 for detailed precautions.

4. Forming Equipment

a. **GOGGLES AND TONGS.** It is imperative that safety glasses be worn around forming equipment of all kinds. Heated metals shall be handled with tongs or by other appropriate means.

b. **CHANGING WORK.** Extreme care must be exercised in changing work on presses, as a wrong motion may result in serious injuries.

13403 HEAT TREATING

1. **Exposure of Personnel.** All heat-treating equipment shall be operated and maintained to minimize hazardous exposure to carbon monoxide, hydrogen cyanide, lead and its compounds, mercury, sulphuric acid, etc.

2. **Furnaces.** Heat-treating furnaces shall be of approved design.

3. Poisonous Fumes and Gases

a. **SALT POTS.** It is essential that no moisture be introduced into a molten salt bath. Salt pots shall be adequately ventilated since they often emit poisonous fumes.

b. **PROTECTIVE ATMOSPHERE FURNACES.** Manufacturer's instructions on the use of protective atmosphere furnaces shall be carefully studied and followed.

c. **COMBUSTIBLE GAS POCKETS.** All types of ovens which are either gas or oil fired, such as core ovens, baking ovens, annealing or ladle ovens, shall be constructed so that all internal parts can be purged of combustible gas pockets before the burners are lighted.

d. **DANGER SIGNS.** During any work involving poisonous fumes and gases, the area shall be placarded with appropriate danger signs, such as "Danger, Poisonous Fumes."

13404 HANDLING MOLTEN METAL

1. **Adequate Lighting.** Adequate lighting shall be provided when handling molten metals.

2. **Location.** Hot metal containers and tongs shall be kept in a location where they will not cause injury.

3. **Tongs.** Tongs of the proper size shall be used in oven operations.

4. **Protective Clothing.** Approved face protective devices, aprons, gloves, leggings, and molder's shoes shall be worn when handling molten metal.

5. **Water.** Precaution shall be exercised to prevent water or wet objects from coming in contact with molten metals as the resultant explosive reaction will cause spattering of the metal. Extraordinary precautions shall be taken to prevent such contact.

6. Splash Hazards

a. **LIFTING.** Cranes and lifting equipment must be adequate and the loads properly rigged.

b. **LOWERING.** Personnel shall stand clear when large pieces are lowered into molten metal. Particular attention shall be called to hollow sections.

13405 MAGNESIUM ALLOYS

1. **Correct Practices.** The correct foundry practice in the use of suitable fluxes during melting as well as of fire extinguishing agents such as G-1 powder shall be observed during the handling and processing of all magnesium base alloys.

2. **Chips and Turnings.** During machining operations care shall be exercised to prevent an accumulation of chips and turnings, as they represent a serious fire hazard.

13406 SANDBLASTING

1. Spaces Used

a. **LIGHTING.** Sandblasting booths and rooms must be adequately lighted with explosion-proof fixtures, and rooms shall have emergency escapes installed on the doors.

b. **ENCLOSURES.** Dry sandblasting shall be done in completely enclosed booths or rooms.

2. **Nonstatic Hose.** Nonstatic hose shall be used to prevent shocks from static electricity.

13407 LEAD, ZINC, AND BERYLLIUM

1. **Toxic Fumes.** Approved type hoods and exhausts vents shall be provided for melting equipment where lead, zinc, or beryllium are being processed at high temperatures. Fumes from these metals are toxic and if inhaled in sufficient quantities will produce serious illness.

13408 ELECTROPLATING SHOPS

The following basic rules for safety shall be followed by all personnel connected with electroplating shops:

1. A deluge-type safety shower shall be installed over the center of each work aisle.
2. The ventilation system must be in operation at all times when plating tanks are uncovered.
3. Personnel must wear proper protective clothing, such as acid-resisting gloves and aprons, goggles and face shields, moisture-proof shoes, etc.
4. A rigid system of preventive maintenance of equipment shall be sustained. In particular, scheduled tests of automatic temperature controls must be conducted.
5. Separate storage facilities shall be provided to isolate incompatible plating solutions.
6. Personnel shall not be permitted to lunch within plating shops, and unauthorized personnel shall not be permitted to enter shops.
7. Assigned personnel shall be given physical examinations as prescribed in NCPI 88.9-2.
8. Shop personnel shall have a thorough knowledge of first aid treatment applicable to electroplating operations.
9. Only abrasive or other approved types of anti-skid floor covering shall be utilized.
10. At least two persons should be present at all times when the shop is in operation, and under no conditions should a single person be permitted to enter the shop without the security of a standby watch.

13409 RADIOACTIVE LUMINOUS COMPOUND

1. **Danger.** Serious injury or death may result from injudicious handling of radioactive luminous compound.

2. **Protective Measures.** Fundamental protective measures to prevent the ingestion or inhalation of the compound during handling, storage, and shipment will be found in chapter 19 of this publication and in the National Bureau of Standards' Handbook No. 27, "Safe Handling of Radioactive Luminous Compound."

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United States Navy
SAFETY PRECAUTIONS

Chapter 14
REFINISHING AND PROTECTION OF SURFACES

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Chapter 14

REFINISHING AND PROTECTION OF SURFACES

Section I

GENERAL

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14101 FIRE HAZARDS

The use of paints, varnishes, lacquers, cleaners, solvents, and other finishing materials containing flammable solvents readily ignitable at comparatively low temperatures involves a marked fire hazard. Liquids containing volatile flammable solvents exposed to evaporation form flammable vapors which, if not cared for by adequate ventilation, may form explosive or flammable mixtures with air. The National Fire Protection Association Inspection Manual, chapters 13 and 17, shall be used as a guide in handling, storing, and using flammable liquids.

14102 CONTAMINATION OF AIR

Vapors and gases from cleaners, solvents, and paints frequently have a harmful toxic effect on the human system. Every precaution should be taken to prevent excess contamination of the air by solvent vapors. This applies to tank-type cleaners, lacquer thinners, benzene, naphtha, paints, solvents, etc.

14103 PAINT STORAGE

Containers holding paints, varnishes, lac-

quers, removers, thinners, cleaners, or any volatile solvents shall be kept tightly closed when not in actual use. They shall be stored in a separate building or in a fire-resisting room which is well ventilated and where the paint material will not be exposed to excessive heat, smoke, sparks, flame, or the direct rays of the sun. Wiping rags and other flammable waste material shall always be placed in tightly closed metal containers, and the containers must be emptied at the end of a day's work. Painters' overalls should be hung in metal lockers.

14104 PAINT REMOVAL WITH TORCH

Whenever a torch is used for paint removal, the operator must guard against accidental ignition of flammable materials in the vicinity.

14105 TOXIC AND POISONOUS SUBSTANCES

Good habits of personal hygiene will prevent lead poisoning. Certain paints and organic solvents irritate or burn the skin and should be handled with approved gloves. See 14202.

Section 2

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14201 PAINTING AREA

1. **Mixing Paint.** Painters should have detached shops or temporary structures where all paint should be mixed, and where paint buckets, brushes, and rags can be kept at the end of the day's work. Only the quantity of oil or paint needed for one day's work shall be taken into the building being painted. Paint mixing and storage shops other than structures of temporary nature should be protected by automatic sprinklers.

2. **No Smoking.** Signs reading "No Smoking Allowed In or Around This Building" should be posted conspicuously inside and outside each paint shop or other building in which paint is used or stored. No open flame of any kind shall be allowed near paint-mixing operations.

3. **Ventilation.** Forced draft ventilation should be provided for personnel engaged in scaling, brush painting, spraying, and in using paint removers.

4. **Aloft or Overside.** Before painting, inspect scaffolding and rigging for safety. Lifelines should always be worn on this work, with the lifeline secured. When brush painting from ladders, the paint bucket should be hung from a ladder rung with a suitable hook, and the painter shall hold onto the ladder with one hand. See chapter 10 of this publication for scaffolds and 07111 for use of ladders.

5. **Housekeeping.** Good housekeeping must be especially stressed where painting work is being done.

14202 HEALTH HAZARDS AND PROTECTIVE EQUIPMENT

1. **Medical Examinations.** Painters must continuously observe good habits of personal hy-

giene to avoid the health hazard of lead poisoning. Medical examination of painters should be conducted periodically in the course of continued work with toxic paint materials.

2. **Respirators.** When torches are used to remove old coats of paint, suitable protection (adequate ventilation or the wearing of a proper type respirator) should always be provided against the possibility of lead poisoning from inhalation of the fumes.

3. **Thorough Washing.** Strict adherence by painters to a system of good personal hygiene in washing with the proper type of soap or detergent, eating, drinking, etc., will practically eliminate the possibility of lead poisoning. Painters should be particularly careful to keep dirty fingers out of the mouth and away from food and other substances going into the mouth. Painters should always wash hands, arms, and face with warm water and soap before eating.

4. **Gloves.** Rubber gloves should always be worn when handling cleaning compounds, thinners, paints, removers, or other materials that may irritate the skin.

5. **Life Jackets.** Each man shall wear a properly fitted life jacket when working in a precarious position near or over water, or at an elevated position, with a lifeline of such length (no more than 2 feet of slack) that the jolt from a fall would not injure him. Since injuries to painters often result from the improper use of ladders and scaffolds, personnel should also observe the precautions given in chapter 10 and 07111.

6. **Antifouling Paint.** Care shall be taken not to get any plastic antifouling paint on the face, hands, or clothing, as it will burn the skin. Masks and gloves shall always be worn when using this kind of paint.

14203 SPRAY PAINTING

1. Dangers. The application of paints, varnishes, lacquers, enamels, wood bleaching liquids, and other flammable liquids by the spray process is more hazardous than brush applications because of the volume and concentration of the work and because spraying produces a residue of flammable character and deposits which are subject to spontaneous ignition. Health hazards due to the presence of potentially harmful substances such as lead, benzol, and silica may also be present in paint spraying operations.

2. Ventilation. To insure immediate removal of vapors and waste residues from spraying operations, complete ventilation of the room is essential. However, adequate ventilation may and usually does require positive means in addition to natural ventilation. A system balanced so as to provide fresh air supply as well as exhaust is therefore recommended. Ordinarily the ventilation necessary for the health and comfort of the operators is sufficient also to remove flammable vapors.

3. Protective Clothing. Operators of spray machines shall wear protective garments which fit snugly at the ankles, neck, and wrists. They shall wear gloves, and approved filter-type respirators while spraying or when mixing dry colors or using other finishing materials which create flammable vapors. They should never inhale the mist from the spray gun.

4. Showers. Where paint-spraying operations are conducted extensively, showers should be installed close by and the employees should use them after every shift.

5. No Smoking. Smoking is prohibited in rooms where spray guns are in operation. The presence of any open flame is forbidden in such locations.

6. Electrical Equipment. Electrical equipment in rooms where paint-spraying or extensive paint mixing operations are carried on, or where large quantities of paints are stored, should be installed in accordance with Class I, Group D requirements of National Electrical Code (NEMA).

7. Fire Fighting. Spray machine operators are to be informed of the location of the near-

est fire-fighting equipment, and they must know how to use such equipment.

8. No Loitering. Only authorized personnel shall be allowed in spray painting rooms.

9. Spray Booths. Where paint spraying operations are regularly conducted inside a building or structure, a standard metal spray booth with an exhaust system using type D motor should be provided which complies with the requirements of the National Board of Fire Underwriters.

a. CLEANING BOOTHS. Compressed air or flammable liquids should not be used for cleaning these booths. If scraping tools are used they shall be made of nonferrous material.

b. SPRINKLERS. Every spray booth should be provided with automatic fire-extinguishing system. If the sprinklers are subject to loading by paint deposits they should be cleaned frequently. The National Fire Protection Association Standards on "Spray Painting and Finishing" give detailed recommendations for safeguarding this process.

10. Hangars. The use of spray painting equipment in aircraft hangars is prohibited, except when done in accordance with Bureau of Yards and Docks Technical Publication "Fire Prevention and Fire Protection" and as provided in the current regulations of the Bureau of Aeronautics.

11. Explosive Areas. Where static electricity is generated by the movement of workmen in the work areas, such as machine shops, hospital operating rooms, anesthetic storage areas, ordnance plants, etc. containing explosive mixtures of flammable vapors, dusts, or gases, a suitable conductive coating should be sprayed over all the work benches, furniture, and floors so these charges may be quickly conducted to ground. Also, in such locations suitable conductive flooring of lead, spark-proof mastic or magnesium oxychloride, conductive linoleum, conductive asphalt tile, or conductive rubber should be installed for added protection.

12. Cleaning Spray Guns. Spray guns, paint containers, and hose must be thoroughly cleaned after use. The adjustments at the back of the gun and the trigger action should be lubricated frequently.

14204 BITUMINOUS AND PLASTIC COATINGS

1. Hazards. There are two types of coatings generally used to protect surfaces against salt-water corrosion. The bituminous type (asphaltic, coal tar) have a volatile vehicle which has toxic and combustible properties. The plastic coatings (chlorinated vinyl resins and other plastics) also have toxic and combustible properties. Although the volatile vehicle of the plastic coatings generally have more severe toxic properties, many of the same safety precautions are applicable to both types.

2. Confined and Unconfined Application. The following precautions shall be observed in applying these coatings both in confined spaces such as the interior of ballast tanks and in the open.

a. PROTECTIVE APPAREL. Legs shall be protected below the knees by approved leggings of canvas material. Shirts must be kept buttoned at the neck and the sleeves rolled down. Leather gauntlet gloves shall be worn. Approved goggles shall be worn except where eye protection is provided by air-supplied respirators or hoods.

b. HOODS. Where these coatings are applied overhead or on surfaces above waist level of the workmen, approved hoods which completely protect the head, face, and neck shall be worn.

c. OPEN FLAME. No smoking or welding or other open flames will be permitted in enclosed spaces, or within 50 feet of the place where these coatings are being applied. The restricted area shall be clearly designated by suitable light barricades and warning signs reading: "DANGER, NO SMOKING."

d. MIXING. Coatings shall be prepared in enclosed mixing equipment located in an open or well-ventilated space. The area shall be barricaded for a distance 30 feet each way from the mixing equipment and "danger—no smoking" signs.

e. MAINTAINING WATCH. A continuous watch should be maintained during application of these coatings, to ensure that all safety precautions are observed.

f. GROUNDING. All spray guns shall be grounded and the ground leads shall be taped

to the spray gun where practicable to discharge static accumulations.

g. RESPIRATORS. Chemical cartridge respirators, protecting against organic solvent vapors, shall be worn by all persons working within 15 feet of either mixing or coating operations, except where coating is done in confined spaces, where air-supplied hoods or respirators shall be used.

h. ACCIDENTAL IGNITION. Extreme care shall be taken by persons engaged in preparing and applying these coatings to eliminate all possible sources of ignition (matches, cigarette lighters, steel buckles, etc.) from their persons. Workmen shall wear canvas boots over their shoes or shall wear rubber footwear where they must stand on steel decking to apply the coatings. All loose steel objects shall be removed from the immediate vicinity of the coating operations.

3. Application in Confined Spaces. In addition to the precautions given in paragraph 2 above, the following precautions shall be observed when applying bituminous and plastic coatings in confined spaces such as interiors of ballast tanks.

a. FORCED VENTILATION. During coating operations all tanks shall be properly force-ventilated.

b. VENTS. Where the venting of the vapors given off by the coatings will create an explosion hazard outside the compartment being coated, water curtains shall be installed at the vents and ventilation shall be continued for at least one hour after the coating operation has been completed and until vapor concentrations remain below those prescribed for the materials involved.

c. RESPIRATORS. Air-supplied respirators shall be worn by all personnel working in enclosed spaces where these coatings are being applied.

d. SPARKS. Coating operations shall not be conducted in enclosed spaces where spark-making apparatus is in use. All electrical equipment except explosion-proof types shall be shut down and all electrical circuits deenergized. Only explosion-proof lights or substitutes shall be used.

e. GAS-FREE TESTING. The gas-free inspection unit shall make continuous tests using com-

bustible gas indicators, of vapor concentrations within tanks being coated, and occasionally in the bottom of the drydock or other lower area where necessary. Vapor concentrations shall be held below those prescribed for the materials involved.

f. PORTABLE LIGHTS. Portable lights shall be hung on stiffeners by means of sparkproof hooks and never wrapped around or draped over supports.

g. SKIN PROTECTION. Areas of workmen's skin not fully protected by clothing shall be coated with a protective ointment designed to protect against organic solvent vapors.

14205 RUST-PREVENTIVE COMPOUNDS

1. Ventilation. When cleaning and spraying with rust-preventive compounds special care shall be taken that working spaces are always well ventilated.

2. Open Flame. Smoking, welding, oxyacetylene burning, or any other operation involving open flames or sparks, shall not be allowed in the same compartment where rust-preventive compound is being used. In the open air, burning shall not be carried on within 20 feet of spraying.

3. Preventing Electric Sparks

a. SHOES. Only nonsparking shoes should be worn by personnel working with rust-preventive compounds.

b. EQUIPMENT. Only explosion-proof electrical equipment shall be operated in such places.

c. GROUNDING SPRAY GUN. A spray gun used for spraying rust-preventive compounds shall be grounded to eliminate any generated electrostatic charge.

4. Personnel Protection

a. OINTMENT. Protective cream or ointment should be applied to parts of the body which are exposed to contact with these vapors.

b. APPAREL. Protective gloves shall be worn when applying cleaning liquid or when spraying, brushing, flushing, or dipping with this compound.

c. RESPIRATORS. When using rust-preventive compounds in a confined or poorly ventilated space, an air-supplied respirator, Navy type A, shall be worn. When spraying, brushing, flushing, or dipping with this compound in the open air, the twin-chemical cartridge respirator, Navy type B-2, shall be worn.

14206 PAINTING BY DIPPING

1. Hazards. Painting by dipping objects in tanks of paint, enamel, varnish, etc., involves the hazard of exposed surfaces of flammable liquids and the evaporation of solvents.

2. Ventilation. Complete ventilation of the area in which dipping operations are carried on is essential. Dipping should preferably be carried on in a detached building or a cut-off section; it should not be conducted in basements where ventilation is difficult to obtain.

3. Tank Covers. Small dip tanks can be protected by automatic-closing covers. Such covers should be held open either by a fusible link or by some form of thermostatic device designed to close the cover and cut off the air supply in case of fire.

4. Overflow Pipes. Overflow pipes should be provided for all dip tanks to prevent spillage and designed so that the contents of the tank can in the event of an emergency be drained to an underground tank located outside the building.

5. Drain Boards. Drain boards on which the surplus finish drips from articles leaving the dip tank are a point of hazard and should be included in the protection for the tank.

6. Open Flame. No smoking or open fires shall be permitted in areas where paint dipping operations are conducted. Only standard methods of heating shall be employed in such areas. The standards of the National Fire Protection Association on dipping tanks give detailed requirements for safeguarding this process.

Section 3

CLEANERS AND SOLVENTS

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14301 VAPORS AND GASES

1. **Ventilation.** Every precaution should be taken to prevent excessive contamination of the air by solvent vapors. Most solvent vapors are heavier than air and require that fresh air be admitted at the top of the room and contaminated air be withdrawn near the deck. Personnel whose duties require them to work around vapors, gases, solvents, acids, etc., shall be instructed in the dangers and hazards of handling these substances.

2. **Vapor Removal From Tanks.** When working with solvents in deep or nearly closed tanks such as vapor degreasing tanks, vapors should be removed in accordance with the recommendations of the manufacturer for the particular equipment used.

3. **Unsafe Concentration.** In operations requiring solvent soaked materials to be transferred to drying ovens, closed operating systems should be adopted wherever possible. These should be continuously maintained to prevent leakage of solvent vapors into the room. Toxic vapors or gases shall not exceed the maximum allowable concentrations (part per million) established by the American Conference of Governmental Industrial Hygienists.

14302 STORAGE AND HANDLING

1. **Method.** Solvents will be handled and stored with regard to their particular properties concerning overheating, combustion, proximity to dangerous materials, and improper ventilation. Good housekeeping should be especially stressed in handling and storage areas.

2. Containers

a. **STORING.** Solvent containers shall be kept tightly closed when not in use. They must be stored with the bung or outlet up. When a container is found to be leaking, the contents shall be immediately transferred to another container. Keep out of the sun and away from heat.

b. **HANDLING.** Never use pressure to empty containers. In case of spillage, flush with plenty of water. Be sure empty containers are completely drained. Keep lights, fire, and sparks away from openings. Never drop containers. Never use empty containers for another purpose.

c. **APPROVED TYPE.** Containers used for the storage and handling of solvents in small quantities should be approved by Underwriters Laboratories for the particular type of solvent.

d. **LABELS.** All containers in which solvents are stored or used shall be plainly marked and instructions thereon shall be carefully read and complied with.

14303 ACIDS

1. **List of Acids.** The following acids are most frequently used in the Navy:

1. Chromic, cresylic(cresol), hydrochloric, hydrofluoric, oxalic, phosphoric, and sulfuric.
2. Hydrocyanic, poison gas; mixed acid (sulfuric and nitric), may cause nitrous gas poisoning; nitric, may cause nitrous gas poisoning; perchloric acid solution, strong oxidant, corrosive fluid; and fuming sulfuric, highly concentrated.

2. Working Precautions. When working with or near acids, operators must prevent splashing, spilling, spraying, or inhalation of acid fumes or gases. In metal pickling, where open tanks are used, acid burns are a particular hazard.

3. Odors. Some acids, hydrogen sulphide for example, provide a warning by odor. However, odor cannot always be relied on for warning, inasmuch as the nose becomes readily fatigued in a short period of time, thus failing to warn.

4. Reflex Respiratory Action. Many acids warn by setting up a reflex respiratory action as in the case of sulfur dioxide which is practically irrespirable. Other gases such as nitrous oxide have little warning effect and set up no respiratory reflexes.

5. Warning

1. Avoid contact with eyes, skin, or clothing.
2. Do not take internally; do not breathe vapors.
3. Store in cool protected spaces and away from direct heat.
4. Do not add water to acids. In diluting acids, the acid must be added to water slowly and with constant mixing.
5. Spillage of some acids may cause fire or liberate dangerous gases.
6. Care should be taken to avoid mixing any organic material (such as alcohol) with chromic acid, since an explosive mixture will result.

6. Treatment. In case of contact with acids, flush the affected part with plenty of water and get medical attention.

14304 ALCOHOLS

1. List of Alcohols. The following alcohols are most frequently used in the Navy:

1. Allyl, butyl, and isopropyl.
2. Ethyl (denatured), and methyl. These alcohols cannot be made nonpoisonous and may be fatal if swallowed. If swallowed, give a tablespoonful of salt in a glass of water or give two teaspoonfuls of baking soda in a glass of water, and get medical attention.

2. Warning

1. Keep alcohols away from heat and open flames.

2. Do not take internally; do not breathe vapors.

3. Avoid contact with eyes, skin, or clothing.

4. Use with adequate ventilation.

3. Treatment. In case of contact with alcohols, flush the affected part with plenty of water, apply a 5 percent solution of bicarbonate of soda, and get medical attention.

14305 AMINES

1. List. The following amines are most frequently used in the Navy: n-butylamine, diethylamine, diethylenetriamine, ethyleneamine, morpholine, monoethanolamine, and triethanolamine.

2. Warning

1. Keep away from heat and open flames.
2. Avoid contact with eyes and skin.
3. Do not breathe vapors.
4. Use with adequate ventilation.

3. Treatment. In case of contact with amines, flush the affected part with plenty of water and get medical attention.

14306 GLYCOLS AND ETHERS

1. List. The following glycols are most frequently used in the Navy: ethylene glycol, and diethylene glycol. Ethers used are n-butyl ether and dichloroethyl ether.

2. Warning for Glycols

1. Avoid prolonged or repeated contact with skin.
2. Avoid prolonged breathing of vapor and do not take internally.
3. Use only with adequate ventilation.

3. Warning for Ethers. The warning for ethers is the same as that for glycols plus the following:

1. Keep ethers away from heat or open flames.
2. Do not take internally.
3. Do not allow to evaporate to near dryness. Addition of water or appropriate reducing agents will lessen peroxide formation.

14307 ESTERS

1. List. The following esters are most frequently used in the Navy: iso-amyl acetate, n-butyl acetate, ethyl acetate, methyl acetate, and isopropyl acetate.

2. Warning

1. Keep esters away from heat and open flames.
2. Avoid contact with eyes and skin.
3. Do not breathe vapors.
4. Use with adequate ventilation.

14308 KETONES

1. **List.** The following ketones are most frequently used in the Navy: acetone, methyl ethylketone, and isopropyl ketone.

2. Warning

1. Keep ketones away from heat, sparks, and open flame.
2. Avoid prolonged or repeated contact with skin.
3. Use with adequate ventilation.
4. Do not take internally or breathe the vapors.

14309 CHLORINATED COMPOUNDS

1. **List.** The following chlorinated compounds are most frequently used in the Navy: chlorinated naphthalene, chlorobenzene, carbon tetrachloride, chloroform, chloroethylene, dichloroethylene, ethyl chloride, ethylene dichloride, methylene chloride, perchloroethylene, and trichloroethylene. Carbon tetrachloride is now allowed in Navy installations only on a very limited basis and used under careful supervision because of its insidiously toxic quality.

2. Warning

1. Keep away from heat and open flame.
2. Do not take internally or breathe the vapors.
3. Avoid contact with the skin.
4. Use only with adequate ventilation.

14310 NITROPARAFFINS

1. **List.** The following nitroparaffins are most frequently used in the Navy: nitromethane, nitroethane, and nitropropane.

2. Warning

1. Keep away from heat and open flame.
2. Do not breathe vapors or take internally.
3. Avoid contact with skin.
4. Use with adequate ventilation.

14311 HYDROCARBONS

1. **List.** The following hydrocarbons are most frequently used in the Navy: benzene, toluene, xylene, naphtha, naphthalene, gasoline, and Stoddard solvent.

2. Warning

1. Keep away from heat, sparks, and open flame.
2. Do not breathe vapors.
3. Avoid contact with skin.
4. Use only with adequate ventilation.

14312 MISCELLANEOUS

1. **Ethyl Methacrylate Monomer and Methyl Methacrylate Monomer**

1. Keep away from heat and open flame.
2. Do not breathe vapor.
3. Avoid contact with eyes, skin, and clothing.
4. Use with adequate ventilation.

2. **Sodium Hydroxide (Caustic Soda)**

1. Do not take internally.
2. Avoid contact with eyes, skin, and clothing.
3. Wear goggles or face shield while handling.
4. To avoid violent spattering while making solutions add sodium hydroxide slowly to the surface of the solution.

3. **Turpentine**

1. Keep away from heat, sparks, and open flame.
2. Do not breathe vapors.
3. Avoid contact with the skin, eyes, and clothing.
4. Use only with adequate ventilation.

14313 DISPOSAL OF MATERIALS

1. **Organic Solvents.** These materials should be reclaimed or disposed of for reclamation or burned.

2. **Acids.** In general, spent acids should be disposed of for reclamation or flushed down the drain with a large excess of water. Care should be taken in the disposition of hydrofluoric acid, since this material is very hazardous to personnel. This acid and cresylic acid

should be neutralized with a base (alkali) before flushing down the drain with a large excess of water.

3. **Alcohols.** These materials should be reclaimed or disposed of for reclamation or flushed down the drain with an excess of water.

4. **Amines.** These materials, which are sometimes present in cleaning compounds, should be flushed down the drain with an excess of water.

5. **Glycols and Ethers.** These materials should be disposed of for reclamation or flushed down the drain with an excess of water.

6. **Esters.** These materials should be disposed of for reclamation or flushed down the drain with an excess of water.

7. **Ketones.** These materials should be disposed of for reclamation. Do not flush down drain.

8. **Chlorinated Compounds.** These materials should be reclaimed or disposed of for reclamation.

9. **Nitroparaffins.** Dispose of for reclamation or burn in open with careful and controlled combustion.

10. **Hydrocarbons.** These materials should be reclaimed or disposed of for reclamation or burned.

11. **Ethyl and Methyl Metacrylate Monomers.** These materials are used in cementing plexiglas, and any unsatisfactory materials should be burned.

12. **Sodium Hydroxide (Caustic Soda).** This material should be neutralized with an acid and flushed down the drain with an excess of water.

13. **Turpentine.** This material should be disposed of for reclamation or burned.

Section 4

ABRASIVE BLASTING

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14401 GENERAL

1. **Abrasive Machine.** The abrasive-blast machine (sometimes referred to as a pot, sand tank, pressure tank, etc.) is a pressure vessel, either single or double, utilizing compressed air and abrasive material, which may be either wet or dry.

2. **Care of Equipment.** As a result of weakness developed by corrosion or from structural damage caused by handling or flying objects, explosion may occur. Adequate maintenance of equipment is basic to the safe operation of abrasive-blast machines. Careful attention to control valves, hose, nozzles, and the strict adherence to correct operating procedures on the part of the operator will prevent accidents.

3. **Work Area.** Abrasive rooms must be adequately lighted with vapor-proof lights, and have emergency escapes installed on the doors.

4. **Dry Abrasive Blasting.** Dry abrasive blasting carried on inside a building shall be done in completely enclosed booths.

5. **Hazards.** The chief dangers to personnel are:

1. explosion
2. breathing abrasive material
3. bodily contact with abrasive stream
4. surges in the sandblast line.

14402 PROTECTIVE CLOTHING

1. **Specifications.** Protective equipment and clothing for abrasive blasting is described in U. S. Navy Manual of Safety Equipment, NAVEXOS P-422.

2. **Apparel.** All blasters shall wear hoods, masks or air helmets of the positive pressure type, steel-toe boots or shoes, rubber or leather gauntlet gloves, and appropriate clothing.

3. **Safety Belts.** Blasters working on staging shall wear safety belts. These belts shall be fastened to lifelines or guard rails at all times.

4. **Hats.** Blast-cleaning machine operators shall wear hard hats (skull guards), goggles, and respirators.

14403 SPECIAL FEATURES OF EQUIPMENT

1. **Air Washer.** This device is a sheet metal chamber of any desired size and shape, to be used with fan duct systems. It is equipped with either a water spray, which will clean the air of coarse dust particles, or steam spray, which will wash out fine dust particles so small as to be virtually invisible. Steam ejectors may be used in lieu of fans in a duct system and in this case a water spray chamber both at the suction and discharge ends of the ejector will wash out all of the dust in the dusty air stream.

2. **External Safety Shut-off.** This is a device which operates when the hose is dropped.

3. **Nonstatic Hose.** Nonstatic hose will be used to prevent shocks from static electricity.

4. **Whip Hose.** A short length of flexible hose between the nozzle and the relatively stiff abrasive-blast hose is generally used to enable the blaster to bend the hose and point the nozzle toward the work at the necessary angle. This short hose must be able to withstand bending under pressure and have good wearing qualities. When bent, the hose will wear unevenly; frequent and thorough inspection is necessary to insure replacement of the hose before an unsafe amount of wear has taken place.

5. **Hose Couplings.** Hose lengths should be joined by metallic couplings secured to the outside of the hose to avoid erosion and weak-

ening of the couplings. Couplings should be so designed as to allow ready joining of the hose lengths and should preferably be of aluminum for light weight.

6. Nozzles

a. ATTACHMENTS. Nozzles must be attached to the hose by a fitting that will positively prevent the nozzle from becoming disengaged and flying through space like a missile. Nozzle attachments shall be of metal and shall fit onto the hose externally.

b. REGULATORS. Nozzle and fitting designs that allow regulations of the air-abrasive stream during blasting are considered unsafe, and shall not be used.

c. HANDLING. Nozzles are usually brittle and striking anything with the nozzle or dropping it should be avoided.

14404 BODILY CONTACT WITH ABRASIVE

1. Direction of Nozzle. Be alert to prevent the air-abrasive mixture from being directed against the blaster himself or another person. Never point the nozzle in the direction of another person, even with the air and abrasive shut off.

2. Hands. All abrasive-blasters should keep hands and other parts of the body away from the discharge end of the nozzle, including times when the abrasive stream is shut off or temporarily clogged.

3. Adjusting Nozzle. Do not attempt to tighten or loosen the nozzle while the abrasive is flowing.

14405 HOSE BREAKAGE

Inspect hose frequently and replace that which shows an unsafe amount of wear. Breakage of the hose, either as a complete separation or through wear, might cause bodily contact with the abrasive stream, and a complete separation in the hose may cause it to whip about and strike a person.

14406 DUST

1. Hazards. Dust from broken-up abrasive and removed rust, scale, and paint is a menace to machinery and to the health of persons in the vicinity.

2. Liquid Hose Line. Dust from blasting of ships' hulls should be suppressed by the use of the rust-inhibiting liquids, fed into the air-abrasive hose at the blasting machine or sprayed from a spray nozzle, concentric with and attached to the abrasive nozzle and fed by a separate liquid line.

3. Suction Ducts. Dust generated by dry blasting of closed spaces aboard ships should be withdrawn by adequate suction ventilation ducts and fans. The dust in the air stream should be washed out in air washers before the air is expelled into the atmosphere.

14407 SURGES IN ABRASIVE-BLAST LINE

1. Danger. Surges in the line can result in recoil action at the nozzle, of sufficient proportions to knock a man from a staging or wrench the hose from his grasp.

2. Surges. Surges are caused by interruptions of the air supply, irregular feeding of abrasives and liquids into the line, and by improper manipulation of the valves at the machine. This is especially likely to occur during change-over from an empty abrasive tank to a full one.

14408 SIGNALS

1. Communication. Adequate means of signaling between the blaster and the machine operator should be maintained.

2. Hand Signals. When the workmen are clearly in sight of each other, well defined and understood hand signals are usually sufficient.

3. Electric Signals. If one workman is invisible to the other, electric signals should be provided. Both horns and lights may be needed. The voltage in the signaling circuit should not exceed six volts, and horns, if used, should be loud enough to be heard over the surrounding noises being made by machinery, metal chipping, and other noise sources.

14409 STAGING

1. Rigidity. Abrasive blasters, being enclosed completely in protective clothing, are restricted in freedom of movement and in ability to see. Furthermore, the blasting hose is stiff to maneuver and has considerable weight. It is

important, therefore, that any staging on which the blaster must work should be as firm, rigid, and steady as possible.

2. Specifications. Staging should be at least 24 inches wide and should be equipped with lifelines or guard rails.

3. Suspended Type. On suspended staging, all lines should be inspected daily. Chafing gear should be used where lines are in contact with metal parts. See chapter 10 section 3, for use of suspended scaffolds.

4. Bumpers. Bumpers or spawls should be used to hold the staging away from the hull (approximately 12 inches). Staging should be arranged for convenience and ease in adjusting height.

5. Lifelines. Lifelines should not be attached to suspended staging but should be secured from a rigid point.

14410 MACHINE OPERATION

1. Changing Tanks. Open and close valves in proper sequence to change over from an empty abrasive tank to a full one. Bleed out the air in the tank before refilling. Reestablish the air pressure after refilling with abrasive.

2. Tending Control Valves. Make sure that during blasting the valves are adequately tended in order to maintain proper mixture of abrasive and liquid. Be alert to close valves promptly if danger develops.

REFINISHING AND PROTECTION OF SURFACES

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United States Navy
SAFETY PRECAUTIONS

Chapter 15
PIPING AND PLUMBING;
SEWAGE AND WATER TREATMENT

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Chapter 15
PIPING AND PLUMBING;
SEWAGE AND WATER TREATMENT

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15101 INTRODUCTION

1. **Minimum Requirements Code.** The approved safety and health requirements for design, installation, inspection and performance of modern plumbing equipment and systems ashore are contained in *Minimum Requirements for Plumbing*, American Society of Mechanical Engineers.

2. **Excavation Work.** Precautions to be observed by pipe fitters and plumbers when engaged in trench excavation work will be found in article 08408.

15102 WORK ON PIPING

1. **Acids.** Acids should be handled or used only in glass or lead containers.

2. **Pouring Joints.** Care shall be exercised to keep out from under hot joints while they are being poured.

3. **Hot Lead.** Hot lead should not be poured over water or wet caulking.

4. **Oily Floors.** If floors are oily and cannot be kept dry, they should be covered with sand or oil-absorbent compound.

5. **Connections.** Any tee, valve, or other service connection which is to be used on piping in maintenance or repair operations should be

very carefully checked to make sure that it is designed to withstand the maximum pressure that might be exerted on it.

15103 SEWER WORK

1. **Leaking Pipes.** Before plumbing work is started on sewer jobs, pits, or tanks where the hazard of broken or leaking pipes may be present, these two preparatory steps shall be taken:

a. **PROTECTIVE DEVICES.** Gas detectors, respirators, inhalators, standard gas masks, safety belts, lifelines, and blowers, shall be provided as needed.

b. **TESTING.** Tests shall be made for explosive gas-air mixtures and oxygen deficiencies in these locations before personnel enter them.

2. **Control Measures.** Where such hazards are found to exist, adequate control measures will be instituted and workmen shall don suitable respiratory equipment as necessary, before entering the structure. Workmen should be instructed as to the kind of canister to use in an emergency, and how to assemble and use this equipment properly. This information will be found in NAVEXOS P-422 *U. S. Navy Manual of Safety Equipment*.

3. Two-Man Watch. At least two men shall be assigned to each sewer job where the hazard of broken or leaking pipes may be present. One man shall always be in a relatively safe position and prepared to render assistance in an emergency.

4. Removing Manhole Cover. To help dissipate any toxic or flammable gas that may exist in a sewer or underground sewage pumping plant, the manhole cover should be removed for several minutes before a workman descends.

15104 PROTECTIVE CLOTHING AND EQUIPMENT

1. Clothing. Goggles, gloves, and other protective clothing provided for personnel safety shall be worn in all pipe fitting, pipe handling, and plumbing work involving the pouring or handling of hot metal or acid, and in any other work where flying material might injure the eyes. Goggles shall be worn when using compressed air to clean out sand, dirt, or scale from pipes before installation.

2. Flameproof and Heatproof Garments. Flameproof garments shall be worn when using blowtorches, welding torches, or similar tools. Plumbers should wear heavy coveralls and leggings which also cover the instep, as a protection against hot lead.

3. Safety Belt. When entering deep tanks, deep sewers, and other deep underground structures, a safety belt and lifeline shall be worn.

4. Blowers. Portable blowers are recommended for all tank, pit, or manhole work where there is any question as to the presence of noxious gases, vapors, or oxygen deficiency. These blowers should have vapor-proof, totally enclosed motors or nonsparking gas engines, and when used they should be placed not less than 6 feet away from the opening and on the leeward side protected from wind, so that they will not serve as a source of ignition for any flammable gas which might be present.

15105 TOOLS—GENERAL

1. Condition. Tools and appliances shall be kept in good condition. Worn tools should be replaced. Check hammer handles frequently; hammers with broken or cracked handles shall

not be used. Nonsparking tools shall be used if explosive mixtures are present during operations.

2. Housekeeping. Tools or materials shall not be allowed to clutter up the floor and become stumbling hazards. Pieces of scrap pipe should be picked up promptly and taken to the scrap bin or to the scrap tubs for the next scheduled pickup.

3. Vise Jaws. Vise jaws should grip the material securely. When threads are being cut, and during backing off operations, the stock should be held firmly.

4. Protection of Threads. Freshly cut threads should be protected with caps or couplings when possible. Care should be exercised to guard against sharp burrs or fins.

5. Pipe Threading. When operating a pipe-threading machine, the clearance of the pipe (elbow and bend) shall always be ascertained before starting the machine.

6. Molten-Lead Pot. A cold ladle or other cold material shall never be dropped into a pot of molten lead, as an explosion may result.

15106 PIPE WRENCHES

1. Clearance. Care should be taken when working in a tight place to be sure that the grip you use will not endanger you, and that there is plenty of clearance in case the wrench should slip.

2. Extension. An extension should never be used on a pipe wrench, as it puts a strain on the wrench which it is not designed to take.

3. Facing Forward. An adjustable pipe wrench should always be faced forward in the direction the handle is to turn. When used that way adjustable wrenches can withstand the greatest force, because the pulling force is applied to the stationary jaw side of the handle.

4. Bite. The bite of an adjustable wrench should always be taken near the middle of the jaws, so that there will be teeth in front if the wrench slips.

5. Strain. Small wrenches should not be overstrained. Wrenches should not be subjected to a severe side strain, and they should never be used as hammers.

15107 HANDLING PIPE

1. **Gloves.** Workmen should wear leather or leather-faced gloves when handling pipe.

2. **Standing Clear.** Workmen should stand to one side when pipe is being unloaded from a truck or railway car.

3. **Piling Pipe.** Pipe should be piled so that the ends of the pipe will be even and not project into walkways. It should be stacked straight, that is, not crossed. Pipe should not be piled directly on the bare ground; racks or dunnage should be provided.

4. **Storing.** Pipe should always be blocked to prevent it from rolling. Where practical, pipe should be stored on specially designed sills or racks. When stacked pipe is being removed it should be taken from the top of the pile.

5. Lifting and Carrying

a. **METHOD.** When lifting heavy pieces of pipe, bend the knees, keep the back line as nearly vertical as possible, and hold the load close to the body; then straighten the knees and pull the load up directly over the feet. Lift with the legs, not with the back.

b. **FORWARD END UP.** Pipe should be carried with the forward end up, so as to clear the heads of other persons.

c. **WARNING FLAG.** When pipe is transported on a vehicle, a red warning flag shall be placed on the projecting ends.

d. **TEAM WORK.** When carrying a long and heavy pipe, each member of the crew should exert the utmost care to work together as a team, while observing the following precautions:

1. All the workmen must understand the signals for lifting and lowering.
2. Each man should make sure that his feet are in the clear.
3. Use the proper tools, either tongs or a carrying bar with a U-shape bend to fit the pipe.
4. Take a firm grip on the lifting bar or tongs; be sure that your hold will not slip.
5. Lift at a given signal of your supervisor or co-worker, with all members of the crew lifting and moving together.
6. Carry the load without sudden starts or

stops; move slowly and take care to place your feet firmly.

7. Stop at the appointed place, and wait for your supervisor's or co-worker's signal to lower.

8. Lower the load carefully, bending at the knees as you did when lifting, and lower slowly along with all the other members of your crew.

6. **Threaded Pipe.** Use caution in handling threaded pipe; the threads are always sharp and will cut the flesh easily. Do not put your hands inside the pipes.

7. **Removing From Pile.** When removing pipe, work from the end of the pile as much as possible. Pipe larger than two inches in diameter should be handled by means of a hardwood pipestick.

8. **Lifting Devices.** Use block and tackle, chain falls, or other lifting devices in handling heavy pipes and fittings.

15108 PIPING SYSTEM REPAIR

1. **Tests.** Hydrostatic tests of the piping on all naval vessels should be conducted quarterly to detect leaks or other defects in the systems. (For the prescribed pressure tests of fuel oil service piping in oil service systems see *Bureau of Ships Manual*, chapter 55, "Fuel Oil and Equipment.")

2. **Strain on Pipe.** Piping shall not be used for handholds or footholds, or be otherwise subjected to strain by such acts as securing chain falls to it or utilizing it as support for weights.

3. **Prevention of Corrosion.** Corrosion of piping shall be prevented by keeping the exterior of pipes properly painted and free from moisture. Graphite or asphaltum paint is recommended for the exterior of piping. As a general rule, copper and brass pipe should not be painted. The piping in bilges, voids, and ballast tanks should not be painted either, unless it is made of steel or iron unprotected by galvanizing, or unless specifications require painting.

4. **Blowing Line.** Before dirt or condensate is blown from a pressure line or equipment, care should be taken to see that all persons nearby are in a safe position.

5. Valves. Before repairs to piping systems are attempted, the valves shall always be locked and the system drained. Workmen opening lines or valves should be watchful for any back pressure which may remain, and for hot lines. They shall wear goggles and suitable clothing as protection against escaping gas or liquid.

6. Acids Present. If acids are encountered when repairing a piping system, the pipes shall be drained, all connecting systems blanked off, and the valves properly cleaned and blocked.

7. Water-Hammer. To prevent water hammer, all water in the steam piping system should be drawn off before steam is admitted.

8. Breaking Flange Joints

a. PRE-CHECK. Before breaking flange joints, particularly in steam and hot water lines or in those salt water lines of ships which have possibility of a direct connection with the sea, special care shall be exercised to make sure that:

1. there is no pressure on the line;
2. the valves which cut pressure off the part undergoing repair are secured in such a manner that they cannot be opened accidentally; and
3. the line is completely drained.

b. PROCEDURE. When breaking joints let two of the flange securing nuts (the diametrically opposite ones, if possible) remain in place while the others are being removed. Then slack off the two remaining nuts sufficiently to allow breaking of the joint. After the line is proved to be clear, all the nuts may be removed. This procedure prevents the scalding of personnel and the flooding of compartments. Care shall always be exercised to prevent vapor explosions of flammable liquids in lines when joints are broken. When separating flanges with a chisel, drive the chisel first through a small sheet of lead or rubber, and let this remain on the chisel to shield personnel in the area from possible spray.

9. Blow-Out Valves to Sea Chest. When opening the steam blowing-out valves to a sea chest to relieve the pressure, care should be exercised to prevent building up a pressure in excess of 35 pounds per square inch in the sea chest.

10. Reducing Valve. When a reducing valve is in use, the inlet valves should be opened

"full." Reducing valves must be drained and warmed up before they are adjusted.

11. Warming and Equalizing. Before opening large steam valves the bypass valves should be opened first to warm the lines and equalize the pressures. If the bypasses are not fitted, the connecting valve should be cracked slightly to accomplish warming and equalizing.

12. High-Pressure Line. Before starting work on a high-pressure air or steam pipe line, the control valves involved shall be wired tight shut, drained, and relieved of all pressure, and the controlling valves tagged with the following sign:

DANGER—DO NOT OPEN

This shall be done prior to breaking or opening the pipe fittings.

13. Cross Connections. When making cross connections, extreme care shall be taken not to connect impotable water systems to potable systems, or water lines to sewer lines.

14. Chlorine Gas Lines. Whenever artificial heating is necessary with any chlorine gas piping, in order to prevent reliquefaction due to unfavorable temperature conditions, such heating should be limited to a maximum temperature of 140° F. Never apply high temperature steam directly to any chlorine gas lines or otherwise raise the temperature of the piping above this limit.

15. Freezing. In freezing weather, auxiliary machinery in exposed positions shall be drained to prevent damage from freezing.

15109 VALVE STEMS

Important valves in a ship's piping system, and all other valves that are likely to stick should be removed once a month or oftener depending upon the frequency which experience shows to be necessary. The causes of sticking valve stems and the remedies are given in *Bureau of Ships Manual*, chapter 48.

15110 INSPECTION OF SEA VALVES IN DRYDOCK

1. Inspection and Assembly. Whenever a ship is placed in drydock, all outboard valves shall be examined under the direction of the engi-

neering officer, and necessary repairs made for placing the outboard valves in efficient condition. When assembling sea gate valves, the gate should be in the half-open position before the bonnet nuts are tightened, to ensure alignment of the guides in the valve bonnet and valve body.

2. Cold-Water Meters. Since the ordinary cold-water meter has certain hard rubber parts which will be ruined by distortion if subjected to temperatures above 100° F., cold-water meters shall never be utilized on hot-water lines.

15111 INSPECTION OF TRAPS

All traps in use shall be tested quarterly, and those found to be leaking shall be repaired at once. Particular care should be exercised to keep clean the strainers located ahead of the traps.

15112 THAWING FROZEN PIPES INSIDE BUILDINGS

In thawing frozen water pipes or heating pipes inside buildings, use hot water. Do not use open flame. A safe method is to wrap the frozen section of the pipe with cloths and pour hot water upon them until the ice gives away. Harm to the floor may be avoided by catching the water in buckets or long pans, or by covering the floor with heavy rags or rugs which will absorb the water.

15113 IDENTIFICATION OF PIPING SYSTEMS

1. Identification of Systems. The MIL Standard No. 101, which became effective 1 January 1951, establishes a color code for visual warnings to accompany the written identification of materials conveyed in all National Military Establishment piping systems and compressed gas cylinders. This color code is applicable to all piping installations where color coding is used in naval industrial plants and shore stations. Exact identification of the material in any of these piping systems is made by means of a title stenciled on the piping, usually in black and white. The appearance of any of

the following six colors on a piping system provides a warning of danger from the hazards in the system, according to the class definitions for warning colors given below:

Class	Standard Color	Class of Material
1-----	Yellow, No. 120----	Flammable materials.
2-----	Brown, No. 102----	Toxic and poisonous materials.
3-----	Blue, No. 116-----	Anesthetic and harmful materials.
4-----	Green, No. 112----	Oxidizing materials.
5-----	Gray, No. 123-----	Physically dangerous materials.
6-----	Red, No. 105-----	Fire protection material.

The primary color warning (either a single color applied as a band completely encircling the piping system, or the entire piping system painted with the primary color) appears on all the dangerous piping systems. An arrow also appears on dangerous piping systems, the arrow indicating the direction of flow of the material in the pipe. Where another hazard distinctly different from that indicated by the primary color on the piping exists, another color is applied to the arrow, that secondary color also being selected in accordance with this color standard.

2. Where No Identification Is Provided. Where piping systems are not properly identified by color schemes, tags, or stencils, and no piping layout is available, care shall be exercised in removing valves and fittings to avoid breaking into live piping systems by mistake.

15114 NEW PIPING WORK

1. Pulsation and Vibration. In the installation of new piping adequate provision must be made for expansion and contraction, and for counter-acting pulsation and vibration.

2. Traps and Aircaps. Steam and air piping shall be equipped with adequate traps or other means for removing liquid from the line. Aircaps shall always be provided on fixtures, and air discharge pipe shall be so installed that pockets where oil may accumulate are avoided.

15115 AIR-COMPRESSOR PIPE LINES

1. **Cleaning as Fire Prevention.** Air-compressor pipe lines through which hot air passes should be kept clean, to avoid the starting of fire in accumulated dust or oil.

2. **Inspection.** The pipe lines, air hose, and shut-off valves of air compressors should be inspected once a month by testing them with soapy water on all joints and connections.

3. **In Freezing Weather.** When shutting down a compressor, all jacket and cooler drains must be opened in freezing weather.

15116 GASOLINE BLOWTORCHES AND PLUMBERS' FURNACES

1. **Directions Must Be Provided.** Every gasoline blowtorch and plumber's furnace shall be provided with a complete set of operating instructions (i. e., directions for filling, pumping up the air pressure, lighting, and extinguishing), and no one shall use a gasoline blowtorch or plumber's furnace until he has read and is familiar with the operating instructions.

2. **Filling Out-of-Doors.** Gasoline blowtorches and plumbers' furnaces should, preferably, be filled out-of-doors. If they are filled indoors, they shall be filled at a point remote from open flame, sparks, or other source of ignition. These torches or furnaces shall not be filled while hot. Safety cans shall be used when blowtorches are being filled.

3. **Prohibited Fuels.** Gasoline containing lead compounds or benzol shall not be used.

4. **Filler Plug.** Laundry soap may be used on threads of the filler plug to ensure a tight seal. The filler plug should be tightened gently; force may ruin the gasket or strip the threads of the plug. The filler plug shall not be loosened while the burner is hot.

5. Pumping up Pressure

a. **APPROVED DEVICES ONLY.** Alterations on torches or furnaces which would permit pumping up the pressure by any method other than the use of pumping devices provided by the torch or furnace manufacturers shall not be made. No device other than the pump supplied with the torch or furnace shall be used to obtain working pressure.

b. **APPROVED PROCEDURE.** Preferably, pressure should not be pumped up while the torch or furnace is lighted. Torches shall not at any time be pumped up to excessive pressure. Five to fifteen strokes of the pump are enough, depending upon the size of the tank and the amount of gasoline in it.

6. **Storing.** Before torches or furnaces are stored the pressure in the tanks shall be released and the valves secured.

7. **Test and Inspection.** Before torches or furnaces are lighted they shall be examined carefully for leaks.

a. **REGULAR INSPECTION BY COMPETENT PERSONNEL.** All torches and furnaces shall be inspected and tested at frequent and regular intervals by competent persons to make sure that the torches and furnaces are in proper operating condition.

b. **DEFECTIVE TORCHES AND FURNACES.** Any defect found in torches or furnaces shall be reported at once to the job supervisor. No torch or furnace which is defective in any way shall be used until after such defect has been properly repaired.

8. Overflow

a. **PRIMING CUP.** The priming cup should not be overfilled, as the gasoline may flow over the tank and become ignited, thus furnishing sufficient heat to develop a dangerous pressure within the tank. If gasoline should flow over the tank it should be carefully wiped off before the torch or furnace is lighted.

b. **HEATING POTS.** When heating pots, care should be taken to prevent overflow or igniting of the material being heated.

9. **Lighting Torches.** Torches or furnaces should not be lighted until the gasoline in the priming cup has nearly all been consumed. Immediately after the torch or furnace has been lighted the flame should be shielded from the wind. Windbreaks should be made of noncombustible material, without bottoms and easily removable. Torches and furnaces should preferably be preheated and lighted out-of-doors.

10. **Stuffing Boxes.** Stuffing boxes shall be kept tight so as to prevent leaks around the valve stem. They shall not be tightened while torches or furnaces are in use.

11. Unventilated Spaces. A torch should not be used in a small unventilated space. It may heat up and thus become a source of danger, and it may exhaust the supply of oxygen, causing the operator to lose consciousness or even his life from suffocation. When such use is unavoidable, it may be necessary to provide air-feed respiratory protective equipment for the workers.

12. Abuse of Torches. Torches should not be dragged across the floor or abused in any other way.

13. Melting of Lead and Zinc. When gasoline blowtorches or plumbers' furnaces are used to melt materials such as lead and zinc, which may give off toxic fumes, care should be taken to see that proper exhaust or ventilation for such fumes is provided. Suitable ventilation should be provided for possible fumes or gases such as carbon monoxide, which may be generated by the appliances themselves. Safety equipment as designated in NavExos P422, "U.S. Manual of Safety Equipment" shall be worn while handling molten metal.

Section 2

SEWAGE AND WATER TREATMENT PLANTS

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15201 INTRODUCTION

The operation of sewage treatment plants and water works is a hazardous occupation fraught with dangers from noxious gases and vapors, physical injury, and infections. Work should be carried on only under the supervision of an experienced workman or operator who is trained in first-aid and familiar with all the occupational hazards of the work.

15202 HOUSEKEEPING

1. **General.** Every effort shall be made to promote good housekeeping at sewage and water treatment plants. Tools shall be picked up, manhole covers promptly replaced, and walkways kept free from grease and oil. The sidewalks of influent and effluent channels, baffles, weirs, launders, and tanks shall be kept clean by hosing, scraping, or brushing. Channels shall be kept free of solids. Dead ends and corners shall be brushed, and all accumulations removed. Icy walks shall be covered with sand.

2. **Fire Prevention.** Sewage treatment plant workers shall never smoke, drop lighted matches, burn tobacco, use open flames (such as pavement asphalt heaters) in or around sewers, screen chambers, sludge digesters, or sewage settling tanks. An ignition spark can even be created while removing manhole covers.

3. **Electrical Apparatus.** Switchboards shall not be used as clothes racks. Special care shall be taken not to work around electrical apparatus or wiring with wet hands, or in wet shoes or clothes.

15203 OPEN TANK PRECAUTIONS

1. **Swimming Requirements.** Workmen on night watch or otherwise required to perform duties alone around open tanks of sewage and water treatment plants shall be required to be capable of swimming at least 100 feet while dressed in the usual type of work clothing.

2. **Lifelines.** When an employee is performing any duties inside the tank guard rail, he shall wear a safety belt and lifeline attached to the guard rail.

3. **Guard Rails and Ladders.** Guard rails shall be maintained around all sewage and water treatment plant open tanks. Hand holds or suitable ladders shall be maintained on one side wall of each open tank. Suitable hand rails six to twelve inches above the water line shall be maintained on each side of open tanks.

15204 PERSONAL PROTECTION

1. **Work Clothes.** Wearing coveralls, or a complete change to work clothes, is recommended during working hours.

2. **Gloves.** Workmen in sewage treatment plants and sewage pumping stations shall wear rubber (synthetic type) gloves to prevent infection while cleaning clogged sludge pumps and while handling screenings, sewage grit, or other filth. Glove protection is particularly important when the hands are chapped or burned, or the skin broken from any wound.

3. **Rubbers.** Rubbers or boots should be worn to keep feet clean and dry while doing sludge pumping and other chores.

4. **Lamps.** Permissible electric explosion-

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proof lights or flash lights should be used in deep, dark manhole shafts to prevent physical injuries.

5. Safety Belts. Personnel entering deep sewers, where removal in case of injury would prove difficult, shall always wear a safety belt and lifeline.

15205 PERSONAL HYGIENE

1. Contact with Filth. It is always wise to avoid actual contact of the hands with sewage, sludge, or other filth.

2. Contamination by Hand. Hands must be kept out of the nose, mouth, and eyes. Before eating, hands should be washed thoroughly with plenty of soap and hot water. The finger nails should be kept short and foreign matter removed with a knife, nail file, or stiff soapy brush. Contaminated ends of cigarettes or cigars, or smoking pipes also may introduce infectious material into the mouth.

15206 SAFETY EQUIPMENT

Sewage and water treatment maintenance workers should be provided with the following safety equipment as applicable and in numbers as required.

Equipment	Use
Portable air blower (gas-motor or electric-motor operated).	Ventilating manholes and other enclosed subterranean structures.
Electric explosion-proof light.	Illumination in tanks and sewers where gas may be or is present.
Safety belt and lifeline.	For entering deep manholes or tanks.
Hose mask.	Respiratory protection in all gas and vapor atmospheres including oxygen deficiency.
Type N canister gas masks.	Respiratory protection for low concentrations of any gas, including carbon monoxide, provided the atmosphere contains sufficient oxygen to support life.
Chlorine canister masks (at plants employing chlorination)	Respiratory protection against chlorine gas leaks.

15207 RESPIRATORY PROTECTIVE APPARATUS

1. Stowage. Masks and canisters should be kept in accessible locations, but in quarters segregated from probable gas hazards.

2. Practice in Use. Personnel directed to use this equipment should practice regularly with it in order to become proficient in putting it on quickly and to become accustomed to breathing through it.

3. Uses of Various Types

a. CANISTER GAS MASKS. This type of equipment is effective for use in low concentrations of specific gases (such as average chlorine leaks), smokes, vapors and dusts, provided the atmosphere contains sufficient oxygen to support life. The type N all purpose or universal canister gas mask is used for low concentrations of any gas, including carbon monoxide, provided the atmosphere contains sufficient oxygen to support life.

b. SELF-CONTAINED OXYGEN BREATHING APPARATUS. This is effective for limited time use against any poisonous gas or oxygen deficient atmosphere, such as when inspecting long, large sewers where a hose mask would be impractical.

c. THE HOSE MASK. This equipment can be used for an unlimited time against any poisonous gas or oxygen deficiency.

15208 PORTABLE VENTILATING EQUIPMENT

Portable blowers equipped with vapor-proof, totally-enclosed motors or non-sparking gas engines, should be used when ventilation of tanks, pits, and manholes is necessary. When employed they should be placed on the leeward side of the manhole and not less than 6 feet from the opening. Compressed-air-driven equipment is also safe for use in such locations. When needed, ventilation equipped should be continued in operation while the work progresses, and tests for the presence of dangerous gases or oxygen deficiency should be made at intervals during the time, as well as before, the work is done.

15209 ILLUMINATION

If illumination is required in sewers, pumping station receiving wells, or tanks where flammable gases may be present, permissible electric cap lamps should be worn if available. Approved safety gas-proof flashlights and extension electric lights with heavily insulated cords may be used.

15210 NONSPARKING TOOLS

1. **Type.** The tools used for opening manholes shall be of the proper type and weight for the work.

2. **Nonsparking Tools.** When repairs must be made around sewage works structures where flammable or explosive gases exist in confined enclosures, such as in a partially empty sludge digester tank, nonsparking tools should be used. Such repair work must always be considered hazardous for other reasons, such as static electricity sparks, sparks from shoe nails, etc., and whenever possible, should be done in an atmosphere containing no flammable gas within or above the explosive range.

15211 WARNING SIGNS

1. **Hazardous Areas.** Warning signs shall be installed near dangerous machinery and blind obstructions, and for any hazardous locations where stumbling may occur.

2. **Fire Prevention.** Warning signs, properly placed, should be used to ban all smoking and open lights in the vicinity of sludge tanks, septic tanks, and sewage conditioning bins. Signs warning against open flames should also be used in sludge digestion tank galleries and in rooms where sludge gas piping and safety devices are located.

3. Manhole Protection

a. **WARNING SIGNS AND GUARDS.** When a manhole is opened, a man with a red flag or a red lantern shall be assigned as a guard to warn pedestrians and vehicular traffic. Barricades with suitable warning signs (such as DANGER, MEN WORKING, SAFETY FIRST, etc.) shall be erected around the manholes. At night, open manholes must be protected with four red lanterns placed about twenty feet away from each other around the manhole in a square formation, with one white lantern located about 10 feet ahead of the opening so as to be easily discernible by approaching traffic.

b. **MANHOLE CAGE.** A manhole cage over the shaft should be provided for protection to the workmen in the sewer because it affords them a handhold in descending and ascending the manhole shaft.

15212 SEWER MAINTENANCE

1. **Ladder Testing.** Workmen descending a manhole shaft to inspect or clean sewers shall try each ladder step or rung carefully before putting their full weight on it to guard against insecure fastening due to corrosion of the rung at the manhole wall.

2. **Helpers for Emergency.** When work is going on in deep sewers at least two men shall be available for lifting workers from the manhole in event of serious injury.

15213 ENTERING DEEP SEWERS

1. **Procedures.** Sewer maintenance crews when entering a large or deep sewer or underground structure where dangerous gas or an oxygen deficiency may be present shall follow these procedures:

1. Allow no smoking or open flames, and guard against sparks.
2. Erect warning signs.
3. Use only safety gas-proof electric lighting equipment.
4. Test the atmosphere for noxious gases and oxygen deficiency.
5. If the atmosphere is normal, workmen may enter with a safety belt attached and with two men available at the top. For extended jobs, the gas tests should be repeated at frequent intervals, depending on circumstances.
6. If oxygen deficiency or gas is found, the structure should be ventilated with pure air by natural or artificial means. The gas tests should be repeated and the atmosphere cleared before entering. Adequate ventilation must be maintained during this work, and the tests frequently repeated.
7. If gas or oxygen deficiency is present and it is not practical to ventilate adequately before workers enter, a hose mask should be worn and extreme care taken to avoid all sources of ignition. Workers should be taught how to use the hose equipment. In these cases they should always use permissible safety lights (not ordinary flashlights), wear rubber boots or nonsparking shoes, and use nonsparking tools.

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2. Assignment of Workers. Work in flammable gas atmospheres is extremely hazardous; it should never be attempted except by those thoroughly familiar with the dangers and fully equipped with the proper protective safety equipment.

15214 PURGING SLUDGE HOLDERS

1. Before Entering. Before entering a digester tank which has been emptied, make sure that it has been purged with live steam or CO₂.

2. Procedure. When purging sludge gas holders, the bottom entrance manhole cover should be removed and the gas vented to the atmosphere through all available openings in the top. All sources of possible ignition for the gas mixture should be carefully controlled during this operation. A combustible gas indicator should then be employed to check the tank atmosphere before entering.

15215 CHLORINE LEAKS

1. Respiratory Apparatus. No one should knowingly enter a room into which chlorine is leaking unless he is wearing a canister gas mask, a self-contained oxygen breathing apparatus, or a hose mask.

2. Conduct in Presence of Chlorine. When chlorine is noticed in the atmosphere workers should avoid panic, refrain from coughing, keep the mouth closed, avoid deep breathing, keep the head high, and withdraw at once from the affected area. The gas mask or oxygen breathing apparatus shall then be put on and the room reentered to shut off the leak if that is possible.

3. Persistent Leaks. The handling of a persistent chlorine leak in a plant is best left to the chlorine supplier.

4. Handling Chlorine Cylinders. Workmen shall handle chlorine cylinders with care. Rough handling of cylinders shall not be tolerated. Workmen should not tamper with the

valve or apply flame, steam, or hot water to it, or place the cylinders near steam pipes or radiators. When using these cylinders they should open the valve slowly, leaving the special wrench in place, closing the valve when the cylinder is empty. Instructions in the use and care of cylinders shall be observed.

15216 FIRST AID FOR CHLORINE POISONING

1. Measures to Be Taken. Should any of the plant personnel become seriously affected by chlorine gas, or be overcome by its action, the following steps should be taken:

1. Call a physician.
2. Remove the affected person at once to open air and away from gas fumes.
3. Place the patient flat on his back with his head slightly elevated. Keep him warm, and do not excite him.
4. If the patient is conscious, give him one-half teaspoonful of essence of peppermint, or a moderate stimulant. Do not give him milk, as milk or cream will usually curdle in the stomach and cause vomiting, which adds to the discomfort of the patient.
5. Insofar as he is able, the person affected should resist the impulse to cough.
6. If the patient is unconscious and not breathing, apply artificial respiration.

15217 PIPING IN TREATMENT PLANTS

1. Cross Connections. Cross connections between the drinking water supply and the sewage or sludge piping or the equipment in sewage and water treatment plants are prohibited. Continuous diligence must be exercised to avoid making such connections.

2. Temporary Piping or Hose. Temporary water flushing pipes or hose shall not be allowed to remain connected with sewage or sludge pipes or tanks after use.

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SAFETY PRECAUTIONS

Chapter 16
PORTABLE TOOLS

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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16101 DEFINITION

The term tools as used in this section shall be understood to mean any small tool, device, or portable power tool normally operated by hand.

16102 GENERAL PRECAUTIONS

1. **Standards.** All tools shall conform to Navy standards as to quality and type, and shall be used only for those purposes for which they were intended.

2. **Good Repair.** All tools in active use shall be maintained in good repair, and all damaged or nonworking tools shall be turned in to the toolkeepers.

3. **Authorized Personnel.** No tools shall be issued to or used by personnel not authorized to use them.

4. **Spark Proof.** Only nonsparking tools shall be used near explosives or in an explosive atmosphere.

5. **Dressing Tools.** Toolkeepers shall issue only those tools they know to be safe. No shock tool with a mushroom head shall be permitted to leave the tool room; all cold chisels, chisel bars, cutters, or other shock tools with chipped, cracked, or mushroomed heads shall be dressed

in accordance with standard practice before they are issued.

6. **Protection of Edges.** Toolkeepers shall give particular attention to keeping the jaws of wrenches in good condition, keeping sharp-edged tools sharp, and protecting the sharp edges while tools are in storage.

7. **Ammunition or Explosives.** On work involving ammunition or exposed explosives, only tools specified in *Bureau of Ordnance* publications pertaining to the ammunition or explosives shall be used.

8. **Inspection.** Portable electric and pneumatic tools shall be kept in the best possible condition, with frequent checking of switches and control valves, electric cord and hose connections.

9. **Temper.** If a tool shows signs of being improperly tempered, the toolkeeper shall withdraw it from service, find the trouble, and have it corrected.

10. **Grinding Wheels.** If a grinding wheel has been abused, the toolkeeper shall give it the "ring test." Toolkeepers should know the safe speeds for abrasive wheels and how to mount and adjust them. Grinding wheels shall be stored in such a manner that mechanical shock will be held to a minimum.

16103 AXES, ADZES, HATCHETS

1. **Inspection.** Axes, adzes, and hatchets shall be inspected before being used; the handle shall be tight in the head, sound, and uncracked; blades shall be sharp and free of defects.

2. **Direction of Cut.** Cuts made with any tool having a cutting edge shall be made in a direction away from the body whenever possible.

3. **Protection of Fellow Workers.** No one shall work with an axe, adze, or hatchet without first making certain that all fellow workers are at a safe distance. No one shall cut toward a fellow worker.

4. **Passing Handle First.** In passing a tool to someone else, the worker shall pass the handle first, keeping a firm grip on the head until the other person has a secure hold on the handle.

5. **Stowage.** Sharpened tools are to be stowed so that their edges will be protected and will not endanger personnel.

16104 BRACES AND BITS

1. **Good Condition.** The jaws of the brace chuck shall be kept in good condition, the gripping edges sharp and clean. Bits shall be kept well sharpened and clean.

2. **Tightening Chuck.** A wrench or pliers shall not be used to tighten the chuck of the brace.

3. **Bit Firmly Gripped.** The bit shall be firmly gripped in the brace.

4. **Bit Breaking Through.** Care shall be exercised to prevent the bit from suddenly breaking through the material being worked.

16105 CHISELS, PUNCHES, DRIFT PINS

1. **Condition.** A burred chisel or a hammer with a mushroomed head shall not be used. If a cold chisel is not properly tempered or sharpened for the job, or if it is defective in any way, it shall not be used.

2. **Holding Chisel.** Cold chisels shall be held in the safest way possible—between the thumb and other four fingers; on horizontal cuts the palm should be up.

3. **Protection from Flying Chips.** Goggles shall be worn by persons using cold chisels. Other persons nearby shall wear goggles or shall be protected from flying chips by screens erected around the work.

4. **Handles of Chisels.** Handles of wood chisels shall be free of cracks and other defects and shall not be mushroomed.

5. **Cupping Chisel in Palm.** When cutting by hand with a wood chisel, the chisel handle shall be cupped in the palm of the hand and pressure exerted away from the body.

6. **Making Cut.** All cuts shall be made away from the body.

7. **Working Close to Others.** Care shall be taken that no other person is close enough to be injured if the chisel should slip or get away from the user.

8. Punches and Drift Pins

a. **CONDITION.** Punches and drift pins shall be kept in good condition and shall be properly tempered and dressed.

b. **STRIKE SHARPLY.** Punches and drift pins shall be struck sharply and squarely; they shall be held firmly.

16106 DRILLS

1. **Condition.** Only straight, undamaged, and properly sharpened drills shall be used.

2. **Chuck.** The chuck shall be tightened securely with the key provided. Wrenches or pliers shall not be used on any chuck. Drill shall be straight and true in chuck.

3. **Work Firmly Clamped.** The work shall be firmly clamped and, if of metal, a center punch shall be used to score the material before the drilling operation is started.

16107 FILES, RASPS

1. **Handles.** Every file or rasp shall be equipped with a securely-fitted, substantial handle, or the tang shall be rounded or cut off square.

2. **Filing Close to Chuck.** Filing work close to the chuck in a lathe shall be done left-handed.

3. **Striking Rasp.** A file or rasp shall never be hit. It shall be tapped gently against a block of wood to clear it. A steel wire brush should be used to clean files.

4. Prohibited Uses

1. An old file or rasp shall not be used to make a punch or chisel.

2. A file shall never be used as a pry or lever.

5. **Carrying Files.** No one shall carry a file about his person without a handle over the tine.

6. Steadying End of File. The file should always be used with one hand grasping the handle and the other steadying the end of the file.

7. Holding Against Material. Files and rasps should be held against the material only on the cutting stroke, never on the return.

8. Selection of File. The correct file shall be used for the job; a fine file for fine work, a coarse file for coarse work.

16108 HAMMERS

1. Selection of Type. Care shall be used in selecting a hammer suitable for the job. The head shall be wedged securely and squarely on the handle and neither the head nor the handle shall be chipped or broken.

2. Free of Grease. The hammer shall be kept clean and free from oil or grease which might cause the handle to slip from the hands or cause the face of the hammer to glance from an object being struck.

3. Striking. The handle of the hammer shall be grasped firmly near the end, the eye kept on the point to be struck, and a true blow struck with the hammer face, which is hardened for this purpose. The hammer face shall not be damaged by striking steel harder than the face itself.

4. Tool Holders. In using sledge hammers to strike chisels or other similar shock tools, the workman holding the tool shall be provided with a tool holder so that in case the sledge misses the tool, it will not strike the holding workman.

5. Drawing Nails. When nails are being drawn with a hammer, after the nail is partly drawn, a piece of wood should be placed under the hammer to increase leverage and reduce the strain.

16109 PIPE CUTTERS

1. Free of Dirt. The pipe cutter shall be kept free of chips and dirt.

2. Oiling. The cutter shall be oiled frequently while the cut is being made.

3. Pressure on Wheel. No wrench, pliers, or other tool shall be used to increase the pressure on the movable wheel.

4. Method of Cutting. When a cut is being made, the employee shall cut a short way, then

back off to tighten the wheel, and then cut again.

5. Supporting Pipe. The end of any long pipe shall be supported during the cutting operation.

6. Removing Burr. After the cut is completed, the burr shall be removed from the pipe with a file or reamer.

16110 PLIERS, SIDE CUTTERS, DIAGONAL CUTTERS

1. Selecting Tool. Care shall be used in selecting the correct plier or cutter for the work to be performed.

2. Correct Tool. Pliers or cutters shall not be used on nuts, pipe fittings, etc. The wrench designed for that particular job shall be used.

3. Condition of Tools. The tool shall be kept free from grease and oil and the teeth or cutting edges shall be kept clean and sharp. The fulcrum pin, rivet, or bolt shall be properly oiled and shall be snug but not tight.

4. Cutting Short Pieces. When cutting short pieces, take care that they do not fly and cause injury.

5. Extensions on Handles. Extensions on the tool handle to increase leverage is prohibited.

6. Protection of Fingers. Fingers shall not be wrapped around the handle of a tool in such a way that they can be pinched or jammed if the tool slips from the work.

16111 SAWS

1. Cutting Across or with Grain. Only saws that are sharp and properly set shall be used. A crosscut saw shall be used for cutting across the grain; a rip saw for cutting with the grain.

2. Guiding Cut. The saw shall be guided with the free hand when starting the cut; only one or two long, slow cuts upward shall be taken and then the hand shall be removed from the danger zone before the sawing is continued.

3. Line with Cut. The saw blade shall be kept in direct line with the cut.

4. Sticking Saw. If the saw sticks in wet or gummy wood, a small amount of oil or paraffin may be applied. In severe cases, a wedge may be used to hold the cut open.

5. Operator's Balance. The employee shall take care not to be thrown off balance when

using one knee to steady the material being sawed.

16112 SPADES, SHOVELS, PICK-AXES

1. **Inspection.** Before the tool is used, it shall be inspected by the worker to be sure that it has a strong, smooth handle and grip free from splinters, checks, and splits, and that the blade is smooth, sharp, and free from twist.

2. **Clearance.** There shall be adequate clearance between men using shovels so that no one will be struck by either tools or material.

3. **Use of Foot.** The area of the ball of the foot, not the instep area, shall be used to press the tool into clay or other stiff material.

4. **Reducing Body Strain.** Unnecessary strain should be avoided by using the leg muscles as much as possible in digging and lifting loads, by being sure of footing, and by keeping the body balanced as much as possible.

5. **Handing Tools.** Tools shall never be thrown or tossed to another person, but shall be handed to him with the handle forward.

6. **Leaving Tools.** A tool shall never be left where personnel may stumble over it or strike against it; it shall be hung up or placed in the corner; the blade of spades and shovels should be stuck securely in the ground.

16113 SCREWDRIVERS

1. **Size.** Care shall be taken to select a screwdriver of the proper size to fit the screw.

2. **Handle.** No screwdriver with a split or splintered handle shall be used.

3. **Starting Screw.** An awl auger drill having bit or driver nail shall be used to start each screw.

4. **Point.** The point of the screwdriver shall be kept in proper shape with a file or grinding wheel.

5. **Working from Ladder.** The worker shall be well braced before driving screws from a ladder.

6. **Correct Use.** A screwdriver shall not be used as a substitute for a punch, chisel, nail puller, etc.

7. **Electrical Work.** Only screwdrivers with insulated handles shall be used for electrical work.

16114 THREADING DIES

1. **Free of Dirt.** Dies shall be kept clean and free of chips and dirt.

2. **Chipped or Burred Edges.** No dies with chipped or burred edges shall be used.

3. **Clamped to Stock.** The die must be firmly clamped to the stock.

4. **Cutting Operation.** The cutting edges shall be oiled before and during the cutting operation. Die shall be backed off a part turn every second revolution.

5. **Hand Die Stock.** When a hand die stock is being used, care shall be taken by the operator to avoid straining himself.

6. **Stowing.** The die and stock shall be thoroughly cleaned and put away after use.

16115 WHETSTONES AND STEELS

1. **Free of Dirt.** Whetstones and oil stones shall be kept free of dirt and cracks.

2. **Guiding Tool.** One hand shall guide the tool while it is being sharpened on the stone.

3. **Guards.** Stones and steels shall be equipped with guards, wherever possible.

4. **Direction of Stroke.** All strokes should be made away from the body.

5. **Block or Spacer.** A stone shall not be used in place of a block or spacer.

6. **Use of Steel.** A steel shall never be used as a pry, chisel, or bar.

16116 WRECKING BARS, CROWBARS

1. **Sharp and Free of Burrs.** Wrecking bars and crowbars shall be kept sharpened and free from burrs.

2. **Slipping.** Care shall be taken that the bar does not slip and cause injury to fellow workers.

3. **Pulling Nails.** When nails or screws are being pulled, wrecking bars shall have a block placed under the jaws after a long nail or screw has been started; this takes some of the strain off the jaws and increases the leverage.

4. **Striking Bar.** Wrecking bars shall never be struck with case-hardened steel tools. Wood, plastic, or soft steel objects shall be used for striking purposes.

16117 WRENCHES

1. Selection of Wrench. Care shall be used in the selection of the right wrench for the job; an extension shall never be used on a wrench.

2. Condition. Only wrenches in good condition shall be used; a bent wrench, if straightened, has been weakened and shall not be used.

3. Strain. A small wrench should not be overstrained. No wrench should be subjected to severe side strain.

4. Use as Hammer. No wrench shall be used as a hammer.

5. Machine in Motion. A wrench shall never be used on material in a machine in motion; the

machine shall be stopped to permit working on the stock.

6. Wrench Faced Forward. An adjustable wrench shall be faced so that the movable jaw will be located forward in the direction in which the handle is to be turned.

7. Bite Near Middle. The bite of an adjustable wrench shall be taken near the middle of the jaws, so there will be teeth in front if the wrench slips; the teeth shall be kept sharp.

8. Working in Confined Space. There shall be adequate clearance between the worker and the wrench; in tight places the worker shall take care that the grip he uses will not endanger him.

Section 2

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16201 GENERAL PRECAUTIONS

1. **Inspection.** All portable power tools shall be kept in good condition, cleaned, oiled, and repaired. They shall be carefully inspected before being used. The switches must operate properly and the cords must be clean and free of defects. The plug shall be clean and sound.

2. **Grounds.** The casings of all electrically driven tools shall be grounded.

3. **Danger of Fire.** Sparking portable electric tools shall not be used in any place where flammable vapors, gases, liquids, or exposed explosives are present.

4. Care of Cords

a. **DANGER OF BEING CUT.** Care shall be taken that cords to electrical tools do not come in contact with sharp objects; they should not be allowed to kink, nor be left where they might be run over.

b. **GREASE OR CHEMICALS.** Cords must not come in contact with oil or grease, hot surfaces, or chemicals.

c. **PATCHING PROHIBITED.** Seriously damaged cords shall be replaced. They are not to be patched with tape.

d. **LOOSELY COILED WHEN STOWED.** The tools shall be stored in a clean, dry place where the cord can be loosely coiled.

16202 POWER TWIST DRILLS

1. **General.** Precautions for hand drills as given in article 16106 are also applicable to power twist drills. In addition, the following requirements shall be met.

2. **Drill Firmly Grasped.** A portable power drill shall be grasped firmly during the operation to prevent it from bucking or breaking loose, thereby causing injury or damage.

3. **Cleaning.** When the work is completed, the drills shall be removed, and drill and motor shall both be well cleaned.

16203 PNEUMATIC TOOLS

1. **Protective Apparel.** Operators using this type of tool shall wear and use necessary personal protective devices.

2. **Authorized Personnel.** Only authorized and trained personnel shall operate pneumatic tools.

3. **When Not in Use.** All pneumatic tools shall be laid down in such a manner that no harm can be done if switch is accidentally tripped. No tool shall be left in a standing position while not in use.

16204 PNEUMATIC ROCK DRILLS

1. **Apparel.** Under no circumstances shall the operator of portable pneumatic drills wear loose or torn clothing. Only trained competent personnel, wearing necessary protective devices, shall operate drills.

2. **Defective Bits.** Bits shall be examined for defects; particular attention shall be paid to bit flutes; these shall be ground to uniform size, sharpness, and length.

3. **Alignment.** Machine shall be held on a straight line with the hole being bored. Tipping of bit is prohibited.

4. **Speed.** Machine shall not be fed too fast.

5. **Firm Footing.** Operator shall be on firm footing before commencing operation.

6. **Hand-Grip Switch.** All drills shall be equipped with a hand-grip switch that will shut off the supply of air when grip is released. This switch shall not be modified or by-passed in any manner without prior approval of the Safety Division of the Management Bureau or the Office of Industrial Relations.

16205 POWER HAMMERS

1. **Pointing Hammer.** No employee shall point any pneumatic hammer at other personnel. Hammers shall be operated in a careful and safe manner at all times.

2. Tool Holder. All hammers shall be equipped with a device for holding the tool in the machine. These safety tool holders shall be inspected at frequent intervals.

3. Air Exhaust. Operators shall not restrict the air exhaust port in any fashion.

4. Hand-Grip Switch. All pneumatic hammers shall be equipped with a hand-grip safety switch. See Pneumatic Rock Drills, paragraph 6, above.

5. Limit of Use. Hammers shall be used only for those purposes for which intended.

6. Gloves. Operators of pneumatic hammers should wear gloves. Body shock and jar is lessened by grasping hammer as lightly as possible.

7. Protective Apparel. All hammer operators

shall wear necessary eye, face, and body protection.

16206 POWER WRENCHES

1. Correct Use. Pneumatic wrench operators shall use a wrench only for those purposes for which it is intended.

2. Hand-Grip Switches. All wrenches shall be equipped with hand-grip safety switches.

3. Inspection. All wrenches shall be inspected frequently by competent personnel.

4. Gloves or Loose Clothing. Operators of pneumatic wrenches should not wear loose fitting articles of clothing.

5. Protective Devices. Wrench operators shall use all protective devices provided.

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United States Navy
SAFETY PRECAUTIONS

Chapter 17
FUELS AND COMPRESSED GASES

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Subsection A
GENERAL

17101 DEFINITION AND SCOPE

This section deals with general precautions for hydrocarbon fuels such as gasoline, diesel oil, kerosene, pentane, heptane, octane, including leaded fuels. Specific directives for truck loading will be found in chapter 4 (Land Transportation), for dock loading in chapter 5 (Seamanship), aviation fueling under Aviation in chapter 3. Specific problems connected with a particular field of activity are covered in the appropriate chapter. Propane, butane, and other liquefied petroleum gases, will be found under the compressed gas section of this chapter.

17102 INSTRUCTION OF PERSONNEL

Because of the hazards involved in the widespread use of gasoline and other hydrocarbon fuels and the varying circumstances under which they are handled, it is important that thorough instructions be given all personnel concerning these dangers and the methods of preventing fires and explosions.

17103 FLASH POINT

The hazards of handling hydrocarbon products are related to flash point. The flash point of a liquid is the lowest temperature at which it

gives off vapor near the surface of the liquid or within a vessel in sufficient quantity to form flammable mixtures with air. Products which give off flammable vapors at or below 80° F., such as gasoline, solvents, and most crude oils are the most hazardous of all petroleum products to handle. For example, gasoline has a flash point of about -45° and crude oil has a flash point of about 60° F. Certain petroleum products may be slightly less hazardous to handle such as kerosene, light and heavy fuels, and lubricating oils which have a flash point above 80° F. Kerosene has a flash point of about 115° F. and will not ignite at ordinary atmospheric temperatures—but if it is heated above 110° F., it will give off sufficient vapors to burn and may explode under certain conditions described in 17202.

17104 STORAGE BUILDINGS

1. **Construction Features.** Nonflammable materials should be used for construction of building in which hydrocarbons and other flammables will be stored. Open type structures are preferred.

2. **Aboveground Tanks.** For large aboveground tanks, concrete, earthen, or other nonflammable material berms are required.

3. Lighting. Explosion-proof type fixtures shall be used.

4. Ventilation. Natural ventilation of open type buildings is sufficient.

5. Lightning. Storage spaces should be adequately protected from lightning by use of lightning arresters.

6. Inspection. Containers should be periodically inspected for leaks at bungs and chimes, and bungs tightened using a new gasket if necessary to stop leaks.

7. Surroundings. The area surrounding hydrocarbon fuel storage should be cleared in order to cut down the spread of fire should it occur.

Subsection B

FIRE AND EXPLOSION

17111 FACTORS NECESSARY FOR COMBUSTION

1. Fuel. Fuel in the form of vapor must be present when anything burns, because it is not the actual substance which is consumed by the flame, but the vapor of the substance in combination with the oxygen of the air. A piece of wood held in a flame will not catch fire until it has been heated to a point where vapor is given off. As previously stated, petroleum products give off flammable vapors at or below 80° F., and therefore constitute greater fire hazards at lower ambient temperatures than those products with a higher flash point. Gasoline, a highly volatile, flammable product, will vaporize at ordinary temperatures and pressures. Therefore, at ordinary temperatures and pressures, gasoline furnishes the first factor necessary for combustion.

2. Oxygen. A gasoline vapor-air mixture containing from about 1 percent to 6 percent gasoline vapor would have sufficient fuel (vapor) and sufficient air (oxygen) to explode. Thus, if anywhere from 1 to 6 cubic feet of gasoline vapor were introduced into a box containing 100 cubic feet of air, a mixture would exist which would readily ignite or explode upon the introduction of flame. Explosion will not take place if the mixture is either too rich or too lean.

3. Heat. Sufficient heat to raise the fuel to its ignition temperature is sometimes supplied unintentionally by a number of sources such as sparks or flame, if necessary precautions are not taken. Spontaneous ignition may also ignite flammable vapors, if they are present.

4. Occurrence. Since all petroleum products, at given temperatures and pressures, furnish the first factor necessary for fire—namely fuel in the form of vapor—all possible sources of ignition must be effectively controlled in the presence of these products. Because of the importance of these factors of ignition in fire precautions, they are discussed at some length in the following paragraphs.

17112 FUEL OIL VAPOR

1. Hazards

a. COMBUSTIBILITY. Fuel oil itself is non-explosive, very difficult to ignite in bulk, and is not normally capable of spontaneous combustion. The vapor from this oil, however, is explosive when mixed with air in certain proportions described in 17202-1.

b. TOXICITY. Vapors of many petroleum products are highly toxic when inhaled or ingested.

2. Characteristics. This vapor is heavier than air and tends to accumulate in low levels, such as bilges and bottoms of tanks, where it may remain undiscovered until ignited by a naked light or spark.

3. Where Found. Vapor is always present in a partly filled tank that has contained fuel oil or other hydrocarbon products unless the vapor has been removed by artificial means. It is expelled through the vents from such tanks while they are being filled.

4. Leaking. A fuel leak allowed to continue in any part of the fuel-burning system may result in an accumulation of enough vapor to form an explosive mixture with the air.

5. Detection of Vapor. Portable vapor-indicator instruments have been developed for detecting the presence of hydrocarbon vapors, and these instruments should be freely utilized, not only for detecting vapors during the tank cleaning process described in chapter 11 of this publication but also for detecting vapors in cofferdams, voids, and storeroom spaces in which oil leaks occur, or in which hydrocarbon vapor is suspected to have collected.

6. Freeing Tanks of Vapor. Whenever a tank is to be entered or whenever any work is to be done in it requiring heated rivets, hammering, etc., or whenever such work is done in the vicinity of open tanks or pipes, all such tanks and all pipes leading to or from such tanks shall be cleared of vapors, after the fuel oil has been removed.

7. Ventilation of Tank. Fuel-oil and other hydrocarbon tanks shall be continuously ventilated by means of a portable blower during the time that work is being done in them.

17113 CONTROLLING VAPORS

1. Spills. Take care that no spills occur.

2. Overflow. Avoid spills from overflow when loading storage tanks by gaging tanks prior to loading.

3. Leaks. Never neglect leaks. Make frequent inspections for leaks in tank seams, tank shells, and pipe joints. All outlets from tanks, except vents, shall be closed.

4. Cleaning Up Spills. If spills or leaks occur, clean them up immediately. Gasoline-soaked ground should be washed with water or covered with sand or dry earth. The area should be policed until flammable vapor has been eliminated.

5. Temperature Control. When temperatures are excessively high, cool storage tanks by sprinkling, or by playing water over them.

6. Closing Containers. Keep gasoline containers, whether empty or full, closed tightly.

7. Empty Containers. Beware of empty gasoline containers.

8. Ventilation. Insure proper ventilation of all enclosed spaces in which vapors may accumulate.

17114 ACCIDENTAL IGNITION CAUSES

Ignition of the explosive mixtures may be caused by an open light, electric spark, static discharge, or spark made by striking metal, heat of the filament of broken electric lamps, smoking, sparks from funnel or galley, fires under boilers, by arcing of the brushes of a motor, by grounds or shorts in electric circuits, by arcing in any electric apparatus, by opening any electric switch carrying current even in a flashlight, by the turning off of an ordinary electric switch, by induced electric charges formed by rubbing of two surfaces together, by motion of a rapidly moving belt, or by nails in shoes hitting or rubbing metal or stones. In fact, a spark can be produced in so many ways that reliance cannot be placed upon safety measures designed to control this feature alone, and the most careful precaution is necessary to prevent the accumulation of gasoline vapor. However, the following precautions shall be most strictly observed and eternal vigilance maintained to prevent the ignition of hydrocarbon vapors.

1. Naked Lights. While oil, gasoline, and other hydrocarbons are being received or discharged, no naked light or smoking and no electrical apparatus liable to spark shall be permitted on board ship or within 50 feet of an oil hose, tank, compartment containing a tank, or pump, or the vent from a tank. The carrying of any matches or cigarette lighters on the person while at work loading, unloading, or cleaning tanks shall be prohibited. Portable lights of all kinds shall be explosion-proof in the vicinity of gasoline and vapor-proof in the vicinity of fluid oil. They shall have wires that are well insulated.

2. Smoking. "No smoking" signs shall be posted conspicuously in the vicinity of the loading and handling of petroleum products, or the cleaning of cargo tanks.

3. Bearer of Naked Light. No tugboat, locomotive, automobile, or other gasoline or diesel propelled equipment will be allowed to approach within 200 feet of loading operations unless specific approval is granted by the vessel's master and the commanding officer or his representative.

4. Clothing. Men engaged in loading, unloading or cleaning tanks shall not wear boots or shoes with exposed nails or metal fastenings. Do not allow any buttons made of sparking metal to be exposed. Beware of key chains, belt buckles, and tools in pockets. In highly hazardous areas, personnel are not permitted to wear outer or under garments made of wool, silk, or synthetic textiles such as rayon and nylon, as these materials can generate sufficient static electricity to cause ignition of highly flammable products.

5. Static Electricity

a. WHEN PRODUCED. Static electricity is produced when gasoline or similar flammable liquids undergo movement such as flow through a hose, agitation of petroleum liquid, or when poured from one receptacle to another or when passed through a filter.

b. DANGER. Dangerous static charges are frequently accumulated and discharged in such a way that fires and explosions result unless proper precautions are taken.

c. MOVING MACHINERY. Moving parts of machines, particularly in dry atmospheres may cause static electricity. Grounding of machines prevents the accumulation of dangerous charges. Moving belts which are not electrically conductive, such as those employed for conveyors and power transmission are also sources of static electricity. One method of combatting this source is the use of rubber belting containing a conducting component.

d. MOVING VEHICLES. Moving trucks and other moving vehicles are capable of generating static. At one time the National Fire Protection Association required trucks to drag ground chains, but this requirement has now been dropped.

e. BONDING NOZZLE. The metal nozzle at the end of gasoline or other hydrocarbon fueling hose should be bonded to the coupling which is attached to the pump by a copper wire inside the hose and the nozzle should be held in contact with any metal tank or receptacle which is being filled with gasoline. An induced charge of electricity of considerable voltage may be accumulated by the friction of fuel flowing through a metal funnel when loosely placed over the inlet of a container

being filled. Therefore, the funnel should be in metallic contact with the supply outlet.

f. BONDING RECEPTACLES. All metal receptacles, funnels, etc., used in the handling of gasoline should be in contact with each other or should be bonded together and grounded.

6. Electrical Storms. Never load or unload flammable products during electrical storms.

7. Repair Work. Do not perform any mechanical work or repair involving hot work such as burning, cutting, or welding unless a permit is issued by proper authority.

8. Sparks From Tools. Hammering of dogs, butterfly nuts, hatches, etc., should never be permitted in compartments containing gasoline or gasoline tanks except in cases of necessity. Spark-proof tools shall be used; if these are unavailable, insert a wooden block between hammer and object.

9. Spontaneous Ignition. If large masses of certain combustible materials which have been soaked in oil are allowed to stand, and the heat liberated from the slow oxidation process is not allowed to escape, the temperature of the mass rises. If this heating is allowed to proceed, the material reaches its ignition temperature and starts to burn. Thus accumulation of oily waste or paint-soaked rags in combustible buildings and containers is a cause of fires. For this reason materials subject to spontaneous ignition must be stored in a way least likely to accelerate oxidation and most likely to cause any heat of oxidation to be absorbed by the surroundings. Use only self-closing metal receptacles for discarding oily waste and dispose of such collections daily.

10. Electrical Apparatus. Inspect electrical apparatus frequently and correct any condition likely to cause sparking. Whenever possible, open switches and pull fuses before work is done on electrical equipment.

11. Engine Operation. Shut off gasoline tank-truck engines during the entire period of filling or discharging unless the truck is designed for engine operation to drive transfer pumps through a power take-off or unless the truck is approved for using gasoline in engines for operating pumps.

12. Vents. Care shall be taken that the flame arresters in the vent pipes from tanks

are kept intact and no smoking, sparks, or flames shall be permitted in the immediate vicinity of such vents. The flame arresters shall be kept free from paint and accumulations of soot or lint.

17115 FIRE FIGHTING EQUIPMENT

Specifications and instructions relative to the care, use, location, etc., of fire-extinguishing equipment are given in Bureau of Ships Manual, Chapter 93 (afloat), and in the United States Navy Structural Fire Fighting Manual (ashore), Opnav-P415-106.

17116 EXTINGUISHING FIRES

1. **Methods.** An oil or hydrocarbon fire can best be extinguished by smothering and ex-

clusion of oxygen. Foam extinguishers and carbon dioxide are the preferred extinguishers. Chemicals or water in the form of fog may be used. Sand and steam are also effective.

2. **Fire in Adjacent Space.** In the event of fire in an adjacent space, the sprinkler system, if provided and manually controlled, should be placed in operation so that the drums and structures may be thoroughly drenched during the continuation of the fire. On shipboard the drainage pumps should be operated so as to carry away the water. Where no sprinkler system is provided and steam smothering is available, the space containing gasoline should be kept sealed and the steam smothering turned on. If sprinkling and steam smothering are not available, fog nozzles attached to hoses from fire plugs should be used for drenching the drums and structures.

Subsection C

HEALTH HAZARDS

17131 TOXIC HAZARD

Petroleum, gasoline, and other petroleum products cause anaesthetic effects when inhaled. Petroleum vapors in a concentration of 0.1 percent by volume may cause slight vertigo at the end of 6 minutes; 0.1 percent can cause vertigo to the extent of inability to walk straight in 4 minutes. Longer exposure or greater concentration may cause unconsciousness or death.

1. **Lower Toxic Limit.** The maximum permissible content of petroleum vapors for any compartment or tank which is to be entered by persons has been fixed at 0.1 percent by volume. Since the lower explosive limit is fixed at one percent by volume, it should be remembered that the concentration of vapors which can be tolerated by a man is far below that required to produce explosive mixtures with air.

2. **Symptoms.** First symptoms of exposure to toxic vapors are headaches, nausea, and dizziness. If such symptoms are noted, they should be taken as warning of the presence of dangerous amounts of vapors in the air. Recovery from these early symptoms is usually prompt

after removal to fresh air. However, if men are overcome by vapors, they should receive immediate medical attention. First aid consists of the prevention of chilling and of the application of artificial respiration if breathing has stopped.

17132 LEAD POISONING

1. **Tetraethyl Lead.** The toxicity of heavy concentrations of vapors from gasoline or other fuel is increased if it contains tetraethyl lead, added for antiknock purposes. This lead compound may be inhaled with the fumes or may enter the body through the mouth or by absorption through the skin and is very poisonous.

2. **Contaminated Tanks.** No tank used for leaded gasoline shall be assumed to be free from the hazard of lead poisoning until the tank has been thoroughly cleaned, even though the combustible gas indicator shows that it is free of gasoline vapor. Special protective clothing and a fresh air hose mask must be worn until such time as the tank is declared lead free.

3. **Repeated Exposure.** Lead poisoning may result from repeated exposure to gasoline va-

pors in an enclosed or inadequately ventilated area where leaded gasoline has been spilled in considerable quantity. There is also danger of lead poisoning from fumes given off by stoves or other gasoline burning equipment in which leaded fuel is used. Therefore a deleading device should be used and adequate ventilation should be insured. If operating personnel are exposed persistently to leaded gasoline, they should be rotated on the job in order to limit the period of individual exposure.

17133 INJURY TO SKIN AND EYES

1. **Contact.** Gasoline may cause skin irritations if allowed to remain in contact with the skin, particularly under soaked clothing or gloves. Clothing or shoes through which gasoline has soaked should be removed at once. Gasoline should be washed from the skin with soap and water. Repeated contact with gasoline removes the protective oils from the skin and causes drying, roughening, chapping, and cracking, and in some cases infections of the skin which may become serious.

2. **Gloves.** Oil-resistant rubber gloves should be worn as protection by persons handling petroleum products.

3. **Gasoline as Cleaner.** Gasoline shall not be used for cleaning purposes under any circumstance.

17134 SWALLOWING GASOLINE

If a person swallows gasoline, first aid should be given immediately. Giving the victim a large quantity of warm, salty water to drink in order to induce vomiting is an effective aid. Medical attention should be secured immediately.

17135 ENTERING TANKS

1. **Permission.** No person or persons shall enter storage tanks or storage spaces which have housed petroleum products until such spaces have been tested by qualified personnel and declared safe for men. See Bureau of Ships Manual, Chapter 92 for details of procedures for flushing, cleaning, and gas-freeing gasoline and oil tanks. Also see American Petroleum Institute Standards for Cleaning Gasoline Tanks for shore station tanks.

2. **Hose Mask.** Anyone entering a tank which has not been thoroughly cleaned, or any compartment in which gasoline has been spilled in any quantity, shall wear a respirator (air-supplied type approved by Bureau of Mines for tank cleaning). He shall have a properly tended lifeline around his body so that he may be hauled out if overcome by gas.

3. **Observation by an Assistant.** Sufficient help should be available to remove an employee from a tank should he be overcome by petroleum vapor. Rescue breathing apparatus (air type) should be available for immediate use since gasoline vapors are asphyxiating.

4. **Omitting Use of Mask.** On diesel fuel oil and boiler fuel tanks, if the vapor indicator registers less than 20 percent of the lower combustible or explosive limit, an employee may enter a tank without respiration equipment to remove sediment and scale. However, vapor tests shall be repeated at frequent intervals and in different sections of the tank, and if the indicator shows the presence of vapors in excess of the above, men must leave the tank and not re-enter unless equipped with air-supplied respirators.

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Subsection A

CHARACTERISTICS

17201 EXPLOSIVE PROPERTIES

Gasoline is a highly volatile liquid giving off a vapor which, when combined with air in the proper proportion, forms an explosive mixture that can be set off by a slight spark or flame. A violent explosion, followed by fire if liquid gasoline is present, will result. Air at ordinary atmospheric temperatures can absorb as much as 28 percent of gasoline vapor, the amount depending on the volatility and grade of the gasoline, the most volatile grades causing the higher percentages.

17202 FORMATION OF EXPLOSIVE MIXTURE

1. **Amount of Gasoline Required.** The lower limit of explosibility of gasoline vapor and air is about 1.4 percent gasoline vapor by volume while the higher limit is about 6.0 percent gasoline vapor in air, by volume. One quart of gasoline left exposed in a closed space will

render explosive upon complete evaporation under ideal conditions about 520 cubic feet of air, or a space of 10 by 6½ by 8 feet. One cubic inch of gasoline will do the same thing for a space of 9 cubic feet or a space 3 by 3 by 1 foot. These figures will give an idea of the small amount of gasoline needed to produce a large volume of explosive mixtures.

2. **Burning Vapor.** Under certain conditions, gasoline or gasoline vapor will burn freely and without explosion if ignited immediately after it is spilled and before there is time for the formation of more than a small volume of explosive vapor.

3. **Heating Container.** A fire on or near a container of gasoline having a restricted opening may generate enough heat to vaporize the gasoline too rapidly for an explosion to occur inside the container. The vapor thus generated will issue from the opening at a high rate and burn as it mixes with the air. However, if the

opening is too small, the vapor pressure may build up and burst the container.

17203 BEHAVIOR OF GASOLINE VAPOR

1. Dangerous Quantities of Vapor. Gasoline vapor is heavier than air, and the highest percentage of vapor in air will be found near the bottom of the stowage space; however the vapor will gradually spread throughout the whole space. It should be recognized that, due to the difficulty of preventing small leaks, danger from sparks or flame is always present wherever gasoline is used or stowed. It is, therefore, of the utmost importance to prevent the accumulation of the vapor in dangerous quantities; this can usually be done by proper ventilation.

2. Vapor Movement. A dangerous feature of gasoline vapor is that it may travel along a current of air for a considerable distance and then be ignited, the flash traveling back to the source of supply and causing an explosion or fire at some distance from the spark or flame. In this connection, whenever gasoline enters a scupper pipe or other drain line, the drain line shall be thoroughly flushed immediately thereafter with a hose from the fire main.

3. Connected Compartments. When a compartment in which gasoline is left is connected, as by an open pipe or drain, with other compartments, gasoline vapor may work its way to them. In such connecting compartments, therefore, there is a danger that gasoline vapor may be present which may be ignited by any source of spark or flame.

Subsection B

STOWAGE SPACES

17211 VENTILATION

1. Required Systems. Natural supply and mechanical exhaust ventilation is provided for spaces containing gasoline tanks or containers and for control compartments in the gasoline-stowage system. As a precaution, the ventilation system should be in operation continuously whenever gasoline is aboard ship. The exhaust should be taken from low points of the compartments. Gasoline stowage tanks and compartments not otherwise ventilated and all spaces into which gasoline vapors issue, shall be continuously ventilated by means of a portable blower during the time work is going on in them. An air motor driven exhaust blower is preferred although explosion-proof electric motor driven blowers are also provided.

2. Portable Drums. All vessels carrying cargo gasoline in drums in enclosed spaces shall be provided with an adequate natural air supply and forced exhaust ventilation to gasoline holds. Ventilation shall be in operation at all times so as to prevent accumulation of gasoline vapors and possible formation of explosive mixtures of gasoline vapor and air. Unless such ventilation is provided, gasoline should not be carried below decks without special

authority from fleet, force, or type commander. If practicable, the gasoline holds shall be protected with an inert gas flooding system.

3. Hull Ventilation. Hull intake blowers shall be stopped in the vicinity of loading connection to prevent gasoline vapors being carried into the ship's ventilation system.

17212 SMOKING AND NAKED LIGHTS

1. Naked Lights. No smoking and no naked lights (such as oil lanterns, open flames, candles, etc.) should be permitted in the vicinity of gasoline drums, cans, stowage, piping, or spaces through which such piping passes. This refers to naked lights for illumination, and not to oxyacetylene flames, welding arcs, etc., in connection with hot work.

2. Lights and Fixtures. In the vicinity of explosive vapors, all lights, whether fixed or portable, shall be of the explosion-proof, non-ferrous wire-guarded type.

3. Repairs. When making repairs or alterations involving hot work or sparks in gasoline holds or necessitating the introduction of steam pipes or electric leads into gasoline holds, precautions as outlined in chapter 11, section 3, shall be taken.

17213 EXPLOSION-PROOF AND SPARK-PROOF EQUIPMENT

All electric motors and switches in gasoline holds and pumps shall be of the explosion-proof type. Tools shall be of the non-sparking type. Personnel shall wear shoes with no exposed ferrous metal fastenings in soles or heels.

17214 JOINTS IN PIPING

Joints and valves in gasoline piping should be inspected at frequent intervals and kept absolutely free from leaks.

17215 HAZARDS IN HOLDS

Where tanks, trucks, and other equipment with gasoline remaining in fuel tanks are lowered into holds, inspection shall be made to be sure none of the tanks, fuel lines, or carburetors are leaking. The hold shall be adequately ventilated and motors shall not be started if there is evidence of accumulation of flammable vapors.

17216 STOWING PORTABLE CONTAINERS

1. **Special Storerooms.** Gasoline when carried in drums or cans for ship's own use shall be carried in the paint and flammable-liquids storeroom, in vessels having such storeroom.

2. **Weather Deck.** In vessels having no flammable-liquid storeroom, gasoline shall be carried in drums or cans on the weather deck and

so located and stowed that the containers may be readily thrown overboard.

3. **Near Stern.** Whenever practicable, subject to the foregoing, weather deck stowage shall be near the stern of the vessel.

4. **Prohibited Areas.** Weather deck storage shall not be in the vicinity of hatches, galleys, heat-producing spaces, ventilation inlets or exhausts from such spaces, ready service magazines, or in or close to the line of fire of guns.

5. **Release Racks.** Quick-release type racks, where fitted, should be inspected frequently to insure proper functioning.

6. **Gasoline Carried Below Deck.** On vessels where gasoline in drums or cases is authorized to be carried as cargo in holds or between decks it shall be stowed in a hold separated by an oil-tight steel structure from all other cargo, with direct access to the weather deck, and not adjacent to boiler or machinery spaces or uptakes. The drums shall be well secured to prevent movement that might cause sparks or rupture of drums, wood dunnage being used for this purpose. *The greatest care should be taken to see that only tight containers are stowed.*

7. **Inspection.** Inspectors must watch every move so that no leaking containers are lifted from the dock and that any containers damaged by being bumped during the placement or transfer within the hold are not allowed to remain without reinspection. Before stowing, all drums shall be carefully inspected especially at chimes and bungs, and any that show signs of leakage shall be rejected.

Subsection C**HANDLING PORTABLE CONTAINERS****17231 CARE OF CONTAINERS**

1. **Designated Use.** Gasoline containers shall not be used as containers for other materials, such as kerosene, linseed oil, paint, turpentine, etc., unless they have been previously surveyed and assigned to such materials and so marked.

2. **Foreign Substances.** Care shall be taken that no dirt, water, or other foreign matter is allowed to get into gasoline containers.

3. **Rough Treatment.** Gasoline drums are normally subject to hard usage and care shall be

exercised that they are not unnecessarily abused. They shall not be struck together or against a structure in such a way as to cause sparks.

17232 ISSUE

All issues of gasoline shall be made under the supervision of a reliable man who shall remain in charge until all containers are securely closed and who shall see that all safety precautions are carried out and that all chances

of fire are eliminated. Drums shall be periodically inspected thereafter for leaks at bungs and chimes, and plugs tightened using a new gasket if necessary. A nonsparking metal faucet installed in a drum will be considered as fulfilling the requirements of a plug.

17233 LEAKY CONTAINERS

1. **Detection.** Inspect for leaky containers, and if any are found, immediately transfer the contents to a tight container and clear the leaking one of any vapor. Defective gaskets and plugs should be replaced.

2. **Cleaning Faulty Tanks.** Water shall not ordinarily be introduced into a gasoline drum, but if a leaky container cannot be made tight by tightening the filling and vent plugs, the drum shall first be filled to overflowing with water, and then emptied and blown through with a steam jet to eliminate any vapor present.

3. **Disposition of Defective Containers.** Defective containers, *after* they have been vapor-freed, shall be returned to a distribution depot for repairs. Repairs, especially those involving HOT WORK, shall NOT be made by the ship's force except in case of emergency, and then not until the container has been vapor-freed.

17234 EMPTYING CONTAINERS

The containers shall be inspected after emptying to insure that all gasoline has been drawn off and then closed by tightening the filling and vent plugs, keeping gaskets in place.

17235 SHIPMENT OF CONTAINERS

Before making shipment of empty containers, they shall be carefully inspected to see that they are not ruptured at the seams and are not punctured, and that gaskets are in place and tightly secured. Unless this is done, they constitute a fire hazard to the carrier.

17236 PREPARATION FOR ACTION

1. **Throwing Drums Overboard.** Gasoline carried in drums, cans, or tanks on the weather decks of vessels should be thrown overboard before action except for such amounts as are necessary to fuel airplanes assigned to the vessel and for emergency gasoline-powered pumps. In such cases drums, cans, or tanks thrown overboard shall be securely closed to minimize fire hazard from floating gasoline.

2. **Flooding System.** Gasoline stowages fitted with inert gas flooding systems should be flooded with inert gas when battle is imminent.

Subsection D

HANDLING BULK GASOLINE

17251 RECEIVING GASOLINE

1. **Use of Hose.** When gasoline is received in bulk, as in aircraft carriers, tenders, supply ships, or at shore stations, it shall be received by hose from the source of delivery.

2. **Loading Tankers.** During loading of tankers, the covers of cargo tanks shall be closed but not clamped. Each tank as filled should be carefully watched, and when cargo enters expansion tanks, loading should be slowed down to guard against overflow. Gasoline should be loaded entirely through the piping. It should not be poured by hose into the hatch. Hatches and ullage plates should be secured after loading is completed.

3. **Insulated Cable.** Before connecting hose,

an insulated copper cable, at least No. 4 U.S. gage, shall be connected between the source of supply and the receiving inlet, with sufficient slack in the wire to prevent tension.

4. **Safety Switch.** The wire shall remain in place until the hose is removed, and a single-pole electric ground safety switch shall be provided for easy operation at some distance from either end of the hose, insuring that no spark will occur except in the switch, which should not be opened when the hose is in place.

17252 ELECTRICAL BONDING

Electrical bonding wires are fabricated into the hose wall to ground the hose terminals. The No. 4 gage ground wire is also connected to

these hose terminals as added precaution to guard against the accidental failure of the hose and hose wire. This would occur if the supply and receiving ships drift apart to the extent that the hose would break and spill gasoline. Immediately after the gasoline started to issue through the hose failure, the hose wire would also break and thus might give a spark to ignite the gasoline. This spark is avoided by the use of the alternate ground wire, which is long enough to remain intact when beyond the point at which the hose would fail. Some ships are equipped with quick release hose couplings to avoid hose breakage under these circumstances, but the alternate ground wire is still essential.

17253 NAKED LIGHTS IN VICINITY

No smoking shall be allowed and no non-approved machinery shall be in operation in the vicinity of gasoline tanks or filling connections, and galley fires in the vicinity shall be extinguished.

17254 FUEL HANDLING AT NIGHT

Gasoline shall be handled by day if possible. When handled at night, special attention must be paid to the observance of all safety precautions and only the most trustworthy personnel should be assigned to the duty.

17255 FILLING TANKS

In filling gasoline tanks:

1. Do not vent through manhole or into interior space.
2. Close hatches and ports in the vicinity of outboard vents.
3. Ventilate interior spaces thoroughly after tanks are filled and secured.

17256 DRAINING OF HOSE

When loading or delivery has been completed and the proper valves closed, gasoline remaining in the piping above the tanks should be drained into the tanks by drawing off water from the water side of the system where provision is made for this method of draining. Where the above provision is not made or where the slope of the piping is such that all of the gasoline in the piping and hose does not drain

back into the tank, gasoline remaining in the piping and hose is drained into containers which can be closed and sealed. After using, gasoline hose should be carefully drained to remove all gasoline and thereby eliminate this as a source for the accumulation of flammable gases.

17257 LARGE GASOLINE LEAKS

1. Emergency Measures. In cases of emergency, where it is for any reason impracticable to apply measures for ventilation given in 11301-11309, whether due to lack of facilities for ventilation, or excessive accumulation of gasoline and generation of gasoline vapor, the most drastic precautions should be exercised along the following lines.

a. EVACUATE PERSONNEL. Remove all personnel from the compartments.

b. SHUT-DOWN OPERATIONS. Stop all electrical machinery (except explosion-proof inclosed motors) and turn off all electric lights (except explosion-proof type) both in the compartment and in immediately adjacent passageways through which air currents might pass from the compartment containing gasoline. Do not operate switches and electric controllers inside these explosive-proof vapor filled compartments. Open the circuits at control stations outside of compartments affected.

c. ELIMINATE SPARK HAZARD. Exercise all possible precautions to prevent accidental sparking from either electrical or mechanical sources, both in the compartment and in passageways immediately adjacent.

d. SHUT OFF DANGEROUS COMPARTMENT. Close and if necessary seal the compartment. Efficient rescue breathing apparatus shall be used by competent personnel; only explosion-proof lights should be used. Foot-gear and implements used by personnel entering the compartment shall be of such character as to eliminate the risk of striking sparks.

e. WATCH BOUNDARIES. The outer boundaries of the affected compartment should be kept under observation for gasoline leakage. Such boundaries may not be tight against gasoline, and the precautionary steps mentioned above may have to be repeated for adjacent compartments.

f. **USE GAS INDICATOR.** Use a portable combustible-gas indicator for positive determination of the existence of gasoline vapor when there is any possibility or suspicion that such vapors may exist in a compartment. *Do not rely upon your sense of smell.* All ships carrying gasoline are provided with these indicators.

g. **REPAIRS.** Do not undertake any repairs to or in such compartments until it is practicable to take the precautions specified in welding and allied processes, 11321-11333.

17258 HYDRAULIC SYSTEMS

1. **Tank Capacity.** Hydraulic stowage systems are designed on the basis of being "full" when each tank contains 5 percent water and 95 percent gasoline. Care must be taken not to exceed this condition as there will be danger of forcing gasoline overboard through the low overflow, or accumulating gasoline in the gravity tank if one is provided.

2. **Empty Tanks.** Tanks are considered to be "empty" when all gasoline has been discharged and displaced with salt water. Insofar as safety precautions are concerned, however, such tanks shall be considered to contain gasoline and its

attendant hazards until such time as the tanks are actually evacuated and cleaned.

3. **Trapped Gasoline.** In particular, there will always be the possibility that, even after prolonged flushing with water, some gasoline will remain trapped in the structure at the top of a tank or in the piping; therefore, the discharge from a gasoline pump or outlet must always be presumed to contain gasoline until or unless the tank has been evacuated of liquid and cleaned.

4. **Water Hammer.** Valves of a gasoline system, and particularly the water supply valve of a hydraulic system, should be operated slowly to avoid water hammer which can result in serious damage to the stowage tanks.

17259 USING LIVE STEAM

In using live steam, due regard must be given to the liability of overheating adjacent compartments, such as magazines, storerooms, etc. After blowing through with live steam, all manhole plates of the tanks shall be removed, and the tanks ventilated by means of a portable blower for at least 2 hours.

Subsection E

JP-4 FUEL

17271 CHARACTERISTICS

JP-4 fuel, although it has some characteristics of gasoline, is by no means the same substance. Due to some of the different characteristics such as lower vapor pressure, high aromatic content, etc., this fuel must be handled and stored very carefully.

17272 TOXICITY

The effect of toxicity, etc., on personnel is not fully known. Tests are being conducted to determine if the elimination of light ends by adding aromatics has made JP-4 more dangerous from a health standpoint. Until tests are completed, precautions must be taken to prevent employees from breathing fumes and to prevent the fuel from coming in contact with

the skin, especially if the skin has abrasions, pimples, or sores.

17273 SPECIAL PRECAUTIONS

It must be remembered that JP-3 or -4 is not kerosene and cannot be handled as such. These fuels, like gasoline, can be handled safely by strictly adhering to the following safety precautions:

1. All hose and pipes must be bonded.
2. Pumps must be permanently grounded.
3. Velocity of discharge from hose or piping must not be greater than 3-feet per second.
4. Containers being filled or decanted must be bonded to filler or suction nozzle in such a manner that bonding leads to ground.

5. All electrical appliances, wiring, motors, flashlights, etc., must be approved for hazardous locations.
6. All loading and unloading facilities for tank cars, tank trucks, and dock-side facilities must be grounded and bonded in accordance with the Naval Fuel Depot Handbook, Appendix F.
7. Filled containers should not be exposed to excessive heat.
8. Extreme caution should be used when gasoline or electric powered equipment (not spark enclosed) is being operated in the area.
9. Employees should be careful not to breathe fumes or allow material to come in contact with the skin.
10. Clothing should be changed immediately if liquid is spilled on it.
11. Goggles and rubber gloves should be used when filling or decanting drums, etc.
12. All tools shall be of the nonsparking type.
13. Employees should not wear shoes with soles or heels attached with steel nails.

Subsection F

SHOP SAFETY

17281 SHOP AREAS

1. **Separate Spaces.** A shop shall have a designated area, or areas, preferably fenced in and separated from buildings, where gasoline is stored and handled.

2. **Smoking.** No smoking shall be tolerated within these areas. "No Smoking" signs shall be prominently displayed.

3. **Fire Extinguisher.** CO₂, dry chemical, or other approved type fire extinguisher for gasoline fires, shall be available at all times.

17282 CONTAINERS

1. **Containers.** Containers of gasoline for shop use shall not exceed 5 gallons in capacity. They shall be of the closed type and approved gasoline containers.

2. **Marking Cans.** Containers shall be painted red and have the word "gasoline" plainly painted on them in yellow. Number 14 brilliant yellow shall be applied to tops including spouts and caps.

3. **Filling.** The containers may be refilled either from a tank truck brought to the designated storage area or from a pump at a filling station.

4. **Spills.** Spilled gasoline should be wiped up and the rags deposited in closed metal cans.

5. **Disposal.** Gasoline should not be dumped into drains or sewers. It may be destroyed by burning in a shallow trench in a safe area under

supervised conditions. (A method is described in BuOrd Code for Guided Missile Propellants, 9-c-7.)

17283 MOBILE EQUIPMENT

1. **Fueling Engines.** No engine of any type shall be refueled while the engine is running.

2. **Distance From Buildings.** Mobile equipment shall be refueled in the open, at least 25 feet from the nearest building.

3. **Signs.** Portable signs worded "Danger—No Smoking" should be placed about 15 feet on either side of mobile equipment if refueled at places other than regular fueling areas.

4. **Spilling.** Care shall be exercised to avoid spilling gasoline when tanks and containers are refilled. Gage a tank before filling to guard against filling it to overflowing.

17284 GASOLINE PROHIBITED AS CLEANER

Gasoline must never be used for cleaning parts, brushes, etc. A suitable cleaning fluid, Stoddard Solvent (Stock No. 51-C1326-75), is available and must be used.

17285 SKIN BURNS

Gasoline spilled on clothing can cause dangerous skin burns even if not ignited. Remove gasoline soaked clothes immediately and dry them in the open air.

Section 3

COAL

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Subsection A

HANDLING COAL

17301 RAILROAD CARS

1. **Safety Wrenches.** A safety wrench should be in the possession of every worker on coal unloading operations to open hopper bottom railroad cars. These wrenches have handles of sufficient length to provide ample leverage, while the ratchet and pawl are so designed as to prevent spinning. Care should be exercised so that the wrench handle is straight at all times, as a bent bar will slip sideways. A safety disc should be used between the wrench handle and the car to prevent injury to the hands of workmen.

2. **Entering Cars.** Extreme care should be exercised by men when entering coal cars during unloading operations to prevent being caught in the slide of the coal and injured or suffocated.

3. **Warning Flags.** When men are engaged in discharging coal cars, blue flags shall be placed near the car or attached to the car track to prevent the possibility of a switching engine moving the car without notice.

4. **Wet or Frozen Coal.** The use of a shovel, tool, or bar with a broad flat blade and a handle approximately eight feet in length is necessary

equipment for removing wet coal from the sides of the cars safely. An extension pipe with an inserted handle attached to a steam hose should be used to free frozen coal from cars whenever thawing sheds or other automatic equipment is not available.

17302 COAL BINS

1. **Ventilation.** There should be adequate ventilation for coal bins. Coal bins (especially those used in storing pulverized coal) should be located as far as possible from any source of flame or heat.

2. **Crushers.** If coal crushers are used all equipment should be guarded and the crusher bins should be properly lighted and drained.

17303 MACHINERY

When using coal unloaders, stackers, cranes, and other handling machinery, care should be taken to keep away from moving parts and such parts should be properly safeguarded. No repairs should be made while machinery is in operation.

Subsection B

DANGER OF SPONTANEOUS IGNITION

17311 STORAGE AREAS

The storage area should be centrally situated on high ground, suitably graded, drained, and surfaced. The storage space should be free from all foreign matter such as leaves, grass, weeds, metal, papers, rags, oil waste, and piles of wood, and if possible it should have a concrete or other hard surface base.

17312 BITUMINOUS COAL STORAGE

1. **Layers.** Bituminous coal should be stored in layers of about three feet in thickness. Each layer should be spread evenly and rolled down with a bulldozer. Generally, piles should not exceed 18 feet in height.

2. **Firing Characteristics.** If coal which has a tendency to fire is stored, it should be subjected to the layer and rolling process, but piles should not exceed 6 feet in height.

3. **Sub-Bituminous Coals.** Sub-bituminous coals ignite spontaneously very readily and should not be stored.

17313 INSPECTION

Coal piles should be inspected frequently to detect smoke, odor of coal gas, or other indications of heating. Also temperatures of piles should be determined by placing pipes, which are closed and pointed at one end, into the pile to a depth of 6 feet and about 15 feet apart, and inserting thermometers to the bottom of the pipe by the use of strings. If the temperature

at any point reaches 180° F. or over, the situation is dangerous and the coal where this temperature prevails should be promptly used in the boilers or turned over.

17314 EXTINGUISHING COAL FIRE

When smouldering or fire has developed in a coal pile, the coal must be promptly used under the boilers or dug out and spread in thin layers on the ground away from the main pile. Water is not effective and should not be used in an effort to put out a fire in a coal pile.

17315 ANTHRACITE STORAGE

Anthracite will not ignite spontaneously and no special precautionary measures are necessary in the storage of anthracite. The amount of sulphur in bituminous coal has an important bearing in the firing characteristics. Ordinarily coal with from 1 percent to 2 percent sulphur will not fire readily and can be safely stored. However, coals containing 2 percent or more of sulphur will ignite more readily and require special precautionary measures in storing.

17316 ADDITIONAL INFORMATION

If the safe storage and handling of coal presents any particular problems, communicate directly with the Fuel Division, Bureau of Supplies and Accounts, Navy Department, Washington 25, D. C. for information.

Section 4

COMPRESSED GASES AND CYLINDERS

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Subsection A

GENERAL

17401 SCOPE

1. **Application.** The instructions in this chapter apply to compressed or liquefied gases used by Navy installations. Cylinders shall be fabricated and tested under Interstate Commerce Commission regulations. The instructions also apply to valves and auxiliary equipment such as safety devices, cylinder caps, etc. Strict compliance with the precautions prescribed in this chapter will prevent many of the accidents which result from misapplication, mishandling, or improper identification of industrial gases and cylinders in the naval service. For instruction covering specific applications of these gases and cylinders, such as oxygen and acetylene used in welding and cutting, see chapter 11; for refrigeration, see chapter 25.

2. **Emergencies.** Due allowance should be made for the hazards which may be peculiar or incident to local conditions of handling, stowage, and use. Where such conditional hazards are met or noted in the course of operations, they should be reported to the cognizant bureau for dissemination to other commands.

3. **Medical Instruction.** Where reference is made to first aid for personnel exposed to gas fumes, it should not be assumed that every acceptable procedure is included, or that the services of medical officers are unnecessary. The

instructions of medical officers, if available, shall be followed in every case.

17402 SHIP-TYPE CYLINDERS

Nonshatterable-type cylinders for high-pressure gases are standard for shipboard use and stores. Only in the event of an emergency or when nonshatterable cylinders (for a given gas or fluid) are not in Navy stores shall shatterable cylinders be accepted for ships storage and use. In such cases the shatterable-type cylinder shall be turned in as soon as possible to the nearest naval supply point in exchange for nonshatterable cylinders when available.

17403 VALVE SAFETY DEVICES

Navy Department specifications and Interstate Commerce Commission regulations require that valves designed for certain services be fitted with safety devices as a safeguard against the building up of hazardous pressures within cylinders from exposure to heat, or from overcharging, etc. In general these safety devices may be divided into four categories based on functional design.

1. **Fusible Plugs.** A fusible plug may be described as a threaded hex head plug, the center of which is filled with fusible metal. When the cylinder is subjected to high temperatures,

the fusible metal melts, permitting gas to escape through the channel previously filled with fusible metal. This type of device is used on chlorine, freon, acetylene, etc.

2. Spring-Loaded Safety Device. Spring-loaded safety devices usually function as "pop" valves when internal pressures in cylinders overcome spring tension, permitting escape of gas. Devices of this sort are used on liquefied petroleum gas valves, and operate generally at about 1.56 percent of the charging pressure indicated for the cylinders (Interstate Commerce Commission approved pressure).

3. Unbacked Safety Cap With Rupture Disk. Unbacked safety caps with rupture disks consist essentially of a safety cap covering a safety port in the valves. The cap retains a disk firmly over the safety port. Under excessive pressure (2,600–3,000 p. s. i.) the safety disk ruptures and allows the gas in the cylinder to vent to atmosphere. This type of safety device is used in carbon dioxide service.

4. Backed Safety Cap With Rupture Disk. Backed safety caps with rupture disks are essentially the same as described in paragraph 3 above, except that the disk is supported by fusible metal contained in the safety caps and blocking off escape ports. In practice, where the cylinders, valves, and, of course, the fusible metal are heated above the melting temperature, and the pressure within the cylinders then is or thereafter approaches 2,600–3,000 p. s. i., the disk ruptures and reduces the pressure. This type of device is used commonly on air, helium, hydrogen, nitrogen, and oxygen valves.

5. Tampering. Do not tamper with the safety devices on valves or cylinders.

6. Striking. Never hammer or strike the valve wheel in attempting to open or close valves. Use only wrenches or tools provided and approved for this purpose.

7. Connections. Be sure that the threads on regulators or other auxiliary equipment are the same as those on cylinder valve outlets. Never force connections that do not fit.

8. Ice Clogged Outlets. In the event that valve outlets have become clogged with ice and it becomes necessary to thaw them out, use warm,

not boiling water. Boiling water will melt fusible plugs and vent cylinders.

17404 PAINTING

1. Frequency. It shall be the responsibility of all ships and commands to repaint cylinders to minimize external corrosion. Repainting shall be done no oftener than is considered necessary for preservation. Navy standard paints are formulated to withstand scrubbing and fading, so that touch-up patch painting is not too obvious. Therefore, touching up rather than complete repainting shall be done when practicable. Repainting in lieu of cleaning must never be permitted.

2. Color. It is also required that each cylinder be identified, with respect to gases or fluids contained therein, by the color of the paints applied for preservation. The Military Standard Color Code—101 will be followed on all compressed cylinders and pipe lines used in Navy installations.

17405 REPAIRING CYLINDERS AND VALVES

1. Maintenance. Cylinders shall be repaired only by ships or by personnel who are specifically authorized to perform such work. To assure that all cylinders aboard ship are in satisfactory and serviceable condition, periodic inspections should be made and cylinders found with any of the following defects should be relieved of pressure in accordance with paragraphs 2, 3, and 4 below and turned into the nearest naval supply point, in exchange for other cylinders:

1. severely dented, gouged, or corroded;
2. evidence of fire damage (carbon deposits on valves or safety plugs of cylinders containing acetylene or other flammable gases);
3. bulges (deformation of cylinders from internal pressures);
4. damaged, split, or leaking seams (low-pressure cylinders containing flammable gases such as acetylene, etc.).

When it is impracticable to bleed defective cylinders, they may be surveyed and jettisoned at sea. An approved survey report should be turned in as required for surveys of ship's materials.

2. Valves. In general, cylinders with leaking or defective valves (stripped threads, bent stems, etc.) shall be turned in to the nearest naval supply point for overhaul. Leakage from valves may be caused by the presence of dirt or foreign particles in the valve or the valve seat. The leakage may sometimes be corrected by partially opening and then closing the valve, to blow out the foreign material. If the leakage continues, the cylinders should be removed to a safe place (in the open if possible) and drained by opening the valve. The cylinders should then be tagged and turned in for overhaul and recharging.

3. Draining Cylinders. Cylinders containing combustible or toxic gases (acetylene, hydrogen, chlorine, etc.) should be drained through pressure regulators and their rates of discharge controlled so that dangerous accumulations of these gases will not occur.

4. Toxic Gases. The utmost caution should be exercised in draining cylinders containing chlorine, sulphur dioxide, anhydrous ammonia, and other toxic or irritant gases. Cylinders containing these gases should be discharged to atmosphere only under conditions assuring the prompt dispersal of these gases without hazard to personnel or property to leeward. Personnel engaged in draining these cylinders should be equipped with the necessary protective clothing, goggles, and breathing masks.

17406 CARE AND TESTING OF CYLINDERS

1. Quinquennial Tests. Interstate Commerce Commission regulations require that practically all cylinders with the exception of those containing acetylene be retested every five years. Regulations specify that cylinders for which prescribed retests have become due must not be charged and shipped until such retests have been properly made. However, cylinders which have been charged prior to the expiration of their retest period are satisfactory for shipment and use subsequent to the date of expiration.

2. Refilling. Do not refill cylinders unless such action is specifically approved by the Bureau concerned and then only in accordance with instructions.

3. Designated Gas. Do not fill any cylinder with a gas other than that gas for which the cylinder has been specifically designated. Explosive mixtures may readily be formed when cylinders containing residual combustible gases such as hydrogen, propane, or acetylene are charged with air or oxygen. The reverse of this procedure is equally hazardous.

4. Changing Markings. Do not remove or change the numbers or marks stamped into cylinders without the specific approval of the Bureau of Supplies and Accounts.

5. Improper Marking. Do not use any gas cylinder which is improperly marked (color of paints, name or gas stenciled on cylinder and valve, etc.). Return all such cylinders to the nearest naval supply depot.

6. Specific Use. Never use cylinders for rollers, supports, or for any purpose other than to carry gas.

7. Regulators. Do not use regulators, pressure gages, manifolds, and related equipment which are provided for a particular gas on cylinders containing different gases.

8. Protection From Heat. Do not subject compressed gas cylinders, either in storage or in service, to a temperature in excess of 130° F. A direct flame should never be permitted to come in contact with any part of a compressed gas cylinder.

9. Protection From Abrasion. Be careful to protect cylinders from objects that will produce a cut or other abrasion in the surface of the metal.

10. Testing for Leaks. When testing for leakage from gas cylinders, use soapy water. Keep the scene of operations well clear of open flames and other sources of potential ignition, such as unshielded lamps, switches, etc.

Subsection B

STOWAGE AND HANDLING

17421 DEFINITIONS

1. **Stowage.** As used herein, the term "stowage" refers to articles under the cognizance of the supply officer, in general stores, to be drawn on for the ship's own use; or articles of cargo being transported. It does not refer to articles removed from stores or cargo and transferred to shops or other locations for use.

2. **Ready Service.** The term "ready service" means articles that have been transferred from store and are physically located in a shop or elsewhere, regardless of whether they are actively being used at a given moment or are being held in reserve in the interim between periods of actual use or in anticipation of a need for immediate use.

17422 HANDLING CYLINDERS

1. **Handle With Care.** Cylinders that contain flammable and/or explosive gases shall be handled with particular care. Every effort should be made to avoid their being dropped or allowed to strike forcefully against each other or any other object. Every precaution shall be taken to prevent bumping or striking the discharge valves during handling operations.

2. **Caps in Place.** The cylinder valve outlet cap and the cylinder valve protecting cap shall both be in place when cylinders are being handled. Unless ready service cylinders are secured in a special portable rack, regulators shall be removed and caps replaced before the cylinders are moved to a new location.

3. **Transporting Cylinders.** When loading or transferring cylinders, especially when using a crane or derrick, the cylinders shall be secured in a cradle, suitable platform, rack, or special container (such as a sand bag, stock 24-B-1062). Neither a sling (line or chain) nor electromagnets shall ever be used. A cylinder moved by hand should be tilted slightly and rolled on its bottom edge, without dragging or sliding. Hooks or lines through valve protection cap shall not be used for hoisting cylinders.

4. **Fixed to Deck.** Cylinders frozen to the deck or otherwise fixed shall not be pried loose with crowbars or similiar tools.

5. **Hand Trucks.** When cylinders are transported on a hand truck, they shall be held securely in position. The truck shall be fastened to a bulkhead or stanchion as soon as the destination is reached. Such truck shall be equal or similar to Standard Stock No. 69-T-1028 modified as follows:

1. Frame shall be sufficiently rigid to permit handling with tackle.
2. Grips or handles shall end in a line vertical with the after side of the wheels to facilitate fastening to a bulkhead.
3. Platform shall be fitted with sides to prevent cylinders from sliding off.
4. Metal strap clamps shall be provided in lieu of chains for retaining the top of the cylinders in place.

17423 STOWAGE OF COMPRESSED GASES, GENERAL

1. **Location.** In general, weather-deck stowage will be provided for flammable and explosive gases. However, in specific cases, below-deck stowage is approved depending on the particular type, mission, and arrangement of the vessel. In such cases, these approved locations are shown on the plans of the vessel.

2. **Separating Flammable and Oxidizing Gases.** Combustible gases shall never be stowed with oxidizing gases. A fire wall shall separate such stowage compartments. However, the inert gases such as helium, nitrogen, carbon dioxide, or argon may be stowed with either flammable or oxidizing gases. Typical oxidizing gases are oxygen, chlorine, etc.

3. **Fire Apparatus and Oxygen Tanks.** Fire extinguishers employing gases, fire-extinguishing cylinders permanently connected to fixed fire-extinguishing systems, and gases and chemical canister for oxygen-breathing apparatus may be stowed in the vicinity in which they are used.

4. Compartments. Compressed gases aboard all vessels, except cargo vessels, shall be stowed only in compartments designated in applicable plans for the vessel.

a. TEMPERATURE. Necessary steps shall be taken to prevent the maximum temperature of the stowage compartment from exceeding 130° F.

b. VENTILATION. When provisions are made for mechanical ventilation, this ventilation shall be operated in accordance with the damage control classification assigned. The classification for closure of this system shall be "Z" or "W."

c. ENTERING. Compartments containing compressed gases shall be ventilated for 15 minutes prior to entry, in event ventilation has been closed down, and a suitable sign to this effect shall be prominently posted on the outside of the access door.

d. GREASE AND OIL. Other flammable materials, especially grease and oil, shall be kept out of all stowage spaces, and stowage space shall be kept clean.

e. ELECTRIC WIRING. In compartments designated for the stowage of flammable or explosive gases, the installation of portable electric wiring and equipment shall not be permitted.

f. VERTICAL POSITION. Each individual cylinder shall be securely fastened in the vertical position (valve end up) by means such as metal collars.

17424 WEATHER-DECK STOWAGE

When compressed gas is stowed on the weather deck, the following precautions shall be observed.

1. Fuel and Oxidizing Gases. Oxygen and chlorine cylinders stowed on the weather deck shall not be in close proximity to fuel gas cylinders.

2. Protection From Elements. Cylinders containing compressed gases should be so stowed that they will be protected insofar as practicable. During winter, cylinder valves shall be protected against accumulation of snow and ice. Warm (not hot) water shall be used to thaw ice accumulations in cylinder valve caps and outlets. During summer, cylinders shall be screened from direct rays of the sun.

3. Corrosion. Every effort shall be taken to prevent corrosion of threaded connections of

cylinders which have been in stowage for extended periods of time. The use of grease or flammable corrosion inhibitors on oxygen cylinders is not permitted.

4. Area. The stowage area shall be as remote as practical from navigating, fire control, and gun stations.

17425 TOXIC HAZARDS

1. Leaking Cylinders. Particular attention should be given to location of cylinder stowage to prevent fumes from leaking cylinders entering ventilating air intakes leading to spaces where personnel may be affected or flammable gases cause explosions.

2. Chlorine and Ammonia. Chlorine and ammonia are toxic and will produce fatal results if breathed in large quantities. In small quantities, they are irritants and cause acute distress by attacking the tissues of the lungs.

3. Inert Gases. Helium, nitrogen, carbon dioxide, and argon are nonflammable gases and may be stowed with flammable gases. Although the inert characteristics of these gases are a fire protection, they will not support respiration, and sufficient concentration in a closed space will cause asphyxiation. Aerosol insecticide and carboxide are also nonflammable; however, where concentrations are present these gases are toxic. Freon likewise is nonflammable but in the presence of fire or red hot metal will decompose into phosgene gas, which is toxic.

17426 EMPTY CYLINDERS

1. Pressure. Though empty cylinders, with valves securely closed and valve protection caps in place, are comparatively less hazardous than full cylinders insofar as stowage is concerned, the former shall be handled and stowed with the same precautions as used with full cylinders. This is important since it is specified elsewhere that cylinders of some gases are not to be completely exhausted but should be considered empty when the gas pressure falls to about 25 p. s. i. gage.

2. Labeling. Empty cylinders should be tagged as "Empty" and segregated from full cylinders.

3. Valves Closed. Valves should be tightly closed and valve protection caps securely fas-

tened to assure the return in good condition of empty cylinders to suppliers.

4. Rotation of Cylinders. Full cylinders should be used in rotation as received from the source of supply.

5. Disposition. Empty cylinders should be delivered to the nearest naval supply depot with valves closed and under some positive pressure, except where the design of the valve does not permit closing, as is the case with fire extinguishers. This is necessary to prevent conden-

sation of atmospheric moisture in cylinders and in the case of acetylene cylinders to prevent loss of the solvent (acetone) and/or entry of air, should the cylinders cool considerably below the temperature at which they were discharged.

6. Drying of Cylinders. Cylinders used for aviators' breathing oxygen, dry nitrogen, dry argon, dry helium, or dry air, which are found to have open valves and/or a positive internal pressure of less than 25 p. s. i. gage, should be tagged "Dry Before Refilling."

Subsection C

GASES IN SHIPS' STORES

17441 ACETYLENE

See chapter 11 for description of hazards and safety precautions.

17442 CARBON DIOXIDE

1. Characteristics. Carbon dioxide is a dangerous asphyxiant because it is not detectable by odor or by color when present in hazardous quantities. It is heavier than air and gives little if any warning to personnel exposed to it until they are completely overcome. The inhalation of carbon dioxide will produce various effects, depending on the length of time the carbon dioxide is breathed.

2. Treatment When Exposed. The treatment of exposed personnel consists of artificial resuscitation, administering oxygen, and keeping the patient warm and quiet.

3. Entering Contaminated Compartment. Do not enter an area or compartment containing hazardous amounts of carbon dioxide without being equipped with a breathing mask and an independent supply of oxygen, or if this is not practicable and the case is urgent, enter only when equipped with lifelines and with assistants standing by outside the area or compartment.

17443 CHLORINE

1. Contamination of Atmosphere. Chlorine should be used only by experienced and properly trained personnel. Where chlorine is used,

good ventilation should be maintained and exposed personnel should be furnished with gas masks approved for protection against chlorine.

2. How Recognized. Where necessary, the presence of chlorine may be detected by using a cloth wet with aqua ammonia. Ammonia in the presence of chlorine produces white fumes.

3. Discharging Cylinder. If it is necessary to immerse chlorine cylinders in a bath of warm water to facilitate discharge, extreme care must be taken not to generate a dangerous pressure in the cylinders. Care should also be taken to maintain the temperature of the water below 130° F. in view of the low melting point of the fusible plugs. In no event should the cylinder valve be submerged nor more than 20 percent of the surface area of the cylinder be under water.

4. Treatment When Exposed

a. INHALATION OF FUMES. When exposed to fumes, patient should be kept warm and quiet, and covered with blankets if necessary. Rest is essential. Place patient on back with head and chest elevated. Call the medical officer immediately.

b. CONTACT OF LIQUID WITH SKIN. Splashes of liquid chlorine or chlorinated water may cause skin irritation and acid burns. In each case, remove clothing immediately and wash exposed part of skin with copious amounts of water or soapy water.

c. OXYGEN AND CO₂. Remove patient to open air. Oxygen may be given if available. Administer intermittently for periods of 2 min-

utes, followed by 2-minute rest periods, over a total period not to exceed 30 minutes. Milk may be given in mild cases to relieve throat irritation.

d. ARTIFICIAL RESPIRATION. Start respiration immediately, pending arrival of the medical officer.

17444 ANHYDROUS AMMONIA

Ammonia is used principally as a refrigerant. Should it become necessary to withdraw ammonia from refrigerating systems into cylinders, care should be taken to avoid overcharging of such cylinders. Only empty ammonia cylinders should be used for this purpose, and in order to insure that they are empty, their valves should be open and the cylinder vented (in the open) for a few minutes. Prior to attaching the cylinders to systems which are to be emptied, they should be carefully weighed and the tare weights (empty weight) noted. The cylinders may then be connected to refrigeration systems for filling, but should be weighed from time to time while filling in order that not more than the appropriate weight (50 or 100 pounds) of gas be charged in the 50- or 100-pound cylinders. If any cylinder be accidentally overfilled, the excess gas should be discharged slowly into water, preferably in the open, where any escaping gas vents to atmosphere.

1. Labeling Empty Cylinders. When cylinders that are used to store ammonia withdrawn from refrigeration systems are later returned to supply depots for refilling, they should be tagged with the explanation that the cylinders were so used.

2. Treatment When Exposed

a. ARTIFICIAL RESPIRATION. Summon the medical officer promptly. If the patient is unconscious, apply artificial respiration.

b. EYES. If the eyes are affected, and the medical officer is not promptly available, hold the lids open and pour water or a 2 percent boric acid solution over the eyeballs and lids, washing thoroughly; then apply two drops of liquid petrolatum or vaseline.

c. SKIN. If the skin is affected, strip the ammonia-saturated clothing from the patient.

Wash affected areas with water, then paint burned surfaces with a saturated solution of picric acid; use boric acid near the eyes. Do not cover burns with clothing or dressings without the approval of the medical officer.

d. NOSE AND THROAT. If the nose and throat are affected, irrigate and spray nostrils with a saline if available; if not, plain water is satisfactory. Encourage patients to drink large amounts of water.

e. BREATHING FUMES. Ammonia gas is lighter than air. Therefore, in going to the rescue of one overcome by ammonia, keep as near to the deck or floor as possible; and if a gas mask is not available, keep a wet cloth or sponge over the mouth and nostrils.

17445 FREON

1. Handling Cylinders. Freon is used as a refrigerant and cylinders containing this gas are subject to the same handling and refilling rules as are given for ammonia cylinders, except that standard freon cylinders are of 10- and 50-pound capacity. (*See also 25201.*)

2. Treatment When Exposed

a. GOGGLES. Personnel with the duty of servicing refrigeration systems with freon should be furnished with safety goggles to eliminate the possibility of liquid freon coming in contact with the eyes and causing injury due to the freezing effect of the liquid.

b. ARTIFICIAL RESPIRATION. Should personnel be overcome due to lack of oxygen in working spaces because of high concentrations of freon gas being present, such personnel should be given artificial respiration as in the case of suffocation.

17446 COMBUSTIBLE GASES (LIQUID PETROLEUM GAS, HYDROGEN, METHYL CHLORIDE, ETC.)

The same safety rules apply to combustible gases as are outlined for acetylene in chapter 11, except that these gases are stable and no hazard is attached to their use at pressures above 15 p. s. i. gage.

17447 OXYGEN

See chapter 11 for description of hazards and safety precautions.

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United States Navy
SAFETY PRECAUTIONS

Chapter 18
ELECTRICITY AND ELECTRONICS

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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CHAPTER 18
ELECTRICITY AND ELECTRONICS

Section 1
GENERAL

Personal Protection, 18101
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18101 PERSONAL PROTECTION

1. **Safety Instruction.** Personnel engaged in electrical work are to be fully informed of the hazards involved. They shall receive proper instruction in accident prevention and first aid procedures.

2. Clothing

a. GENERAL SAFETY MEASURES

1. Do not work on electrical apparatus with wet hands or while wearing any wet clothing.
2. When performing work on or within four feet of electrical equipment, do not wear any clothing with exposed zippers, buttons, or other metal fasteners.
3. Personnel shall wear no loose or flapping clothing.
4. No flammable articles, such as celluloid cap visors, shall be worn.
5. Personnel shall remove rings, wrist watches, bracelets, and other similar metal items before performing work on or within four feet of electrical equipment with exposed current-carrying parts.
6. Personnel shall wear high-cut shoes with sewed soles for work on live electrical circuits where the voltage is about 50 volts. Thin-soled shoes and shoes with metal plates or hobnails are prohibited. Safety shoes with nonconductive soles should be worn if available.

b. SPECIAL PROTECTIVE CLOTHING

(1) *Rubber Gloves.* Rubber gloves should be worn by personnel likely to come in contact with live conductors or current-carrying parts of equipment in the course of their work where the system voltage exceeds 150 volts. No work should ever be done on live conductors of any voltage except in case of emergency. If the work requires that one hand be free of cover-

ing, a rubber glove should be worn on the other. The following safety rules shall apply in the use of gloves.

1. Personnel intending to work on live circuits, or on equipment containing exposed current-carrying parts where the voltage exceeds 150 volts, shall put on rubber gloves before coming within reach of the live parts and shall not remove them until entirely clear of such equipment.
2. Leather protectors shall be worn over rubber gloves when conditions warrant.
3. Gauntlets of rubber gloves shall never be rolled down.
4. Personnel shall wear rubber gloves when cutting a supposedly dead cable or testing supposedly burned-out transformers.
5. Equipment used for testing rubber gloves shall be approved by the Underwriters Laboratory. It is recommended that rubber gloves used for work on circuit voltages from 150 to 3,000 volts be turned in at least every two weeks for retesting. Tests may be performed by Naval activities having suitable equipment, or arrangements may be made with utilities supplying power for such tests.
6. All rubber protective equipment should be given a thorough visual inspection and an electrical test whenever the last test was made more than six months prior to issue or delivery for actual use of personnel.

(2) *Defective Personal Equipment.* Never wear protective equipment which you believe may be defective. Such equipment is to be tagged and turned in for repair or replacement.

3. Other Protective Equipment

a. WARNING SIGNS AND GUARDS. Danger signs and suitable guards, adequately illuminated,

shall be provided to warn all personnel wherever live parts of electrical circuits or equipment are exposed when the circuit voltage exceeds 50 volts. See 18302,5 for warning signs specified for shipboard and shore electronics installations.

b. INSULATED FLOOR COVERING. On all circuits where the voltage is in excess of 50 volts, and where the deck or walls are of metallic construction, the worker should be insulated from accidental ground by use of approved insulating material. The insulating material shall have the following qualities:

1. It shall be dry, without holes, and shall not contain conducting materials.
2. The voltage rating for which it is made shall be clearly marked on the material, and the proper material shall be used so that adequate protection from the voltage can be supplied.
3. On voltage below 600 volts, dry wood may be used, or, as an alternative, at least two layers of dry canvas, sheets of phenolic material, or rubber mats. Where other than approved rubber mats are used, the marking provision of paragraph 3b2 above shall not apply; however, care shall be taken to insure that substitute material is capable of providing the required insulation value.
4. Care shall be exercised to insure that moisture, dust, metal chips, etc. which may collect on insulating materials is removed at once. Small deposits of such materials can become very great electrical hazards.
5. All insulating materials on machinery and in the area shall be kept free of oil, grease, carbon dust, etc., since such deposits destroy insulation.

c. INSULATED BARRIERS. Whenever work of a nature other than electrical is to be performed in an area adjacent to that in which there are any exposed parts of an electrical circuit, regardless of voltage, insulating barriers shall be provided between the work area and that in which the live electrical parts are located.

d. INSULATED STOOLS. Whenever it is necessary to perform work on electrical circuits or equipment in wet or damp locations, dry

wooden stools or platforms shall be provided so that there will be no possibility of contact between the wet or damp floor and workmen's shoes.

e. INSULATING RUBBER TAPE. Metal tool handles shall be covered with rubber insulating tape. Use of plastic or cambric sleeving or friction tape alone is prohibited for this purpose.

f. FUSE BOX COVERS AND OTHER SUCH EQUIPMENT. The covers for fuse boxes, junction boxes, switch boxes, and other types of wiring equipment and accessories shall, except when work is being done on them, be kept securely closed.

g. METAL ENCLOSURES. Protective metal enclosures for electrical and electronic equipment, metal bases, frames, etc., are to be effectively grounded. Grounding is to be checked at regular intervals and after repair work has been performed. Total resistance from enclosure, base, frame, etc. to positive ground to which connected, shall not exceed 25 ohms.

h. INTERLOCKS AND SAFETY DEVICES. Safety devices such as interlocks, overload relays, and fuses shall not be altered or disconnected except for replacement, nor shall safeguard circuits be modified without specific authority.

i. TOOLS. Unserviceable tools shall be condemned and repaired; they shall be replaced if possible. Tool handles, either wooden or plastic, which are cracked, chipped, splintered, or broken must be replaced.

4. Special Precautions Against Electrical Shock. Strict adherence to the rules on the use of proper clothing and equipment, outlined above, is essential in an area where electrical work is being done and serves as an aid to the prevention of electric shock. Other safety measures to be taken are as follows:

a. CAUTION WITH METAL PARTS. It is essential that personnel also keep in mind the fact that various pieces of equipment not ordinarily thought of as conductive can be dangerous. The following rules shall apply when working with electricity:

1. Cleaning brushes, dusters, brooms, and other such equipment which may be used within four feet of, or on, electrical equipment having exposed metal parts

shall not themselves contain any exposed metal parts.

2. Miscellaneous tools and equipment containing metal parts, such as metal tapes, cloth tapes with embedded metallic threads, wooden scales with metal trimmings, etc. shall not be used in any area within four feet of electrical equipment or wiring having exposed current-carrying parts.

b. ILLUMINATION. It is the responsibility of the supervisor to ensure that sufficient illumination is provided for safe and expeditious performance of work involving electrical wiring and equipment. See chapter 2 for minimum lighting necessary for specified types of work.

c. ATTENTION TO WORK. Personnel working on electrical circuits shall exercise extreme care to ensure that their attention does not wander and that attention is not diverted from the work at hand.

d. ACCIDENTAL GROUNDS AND SHORT CIRCUITS. Continual inspection with awareness of the danger of accidental grounds and short circuits is necessary for the safety of personnel. Any dangerous conditions shall be reported and should be corrected if possible before any further work is done in the area.

e. INSULATION. Do not trust insulation when electrical work is to be performed. Insulation may appear to be in perfect condition but if defective, may result in serious injury from electric shock.

f. LIVE CIRCUITS

1. When working on live circuits exercise as much care to avoid contact with low voltages as with high voltages. Circuits of 50 volts or less usually are considered safe (except for fire hazard).
2. Never take a shock intentionally from any voltage. This is a dangerous practice and is strictly forbidden. On circuits under 600 volts when it is necessary to determine whether a circuit is alive, a voltmeter, voltage tester, test lamp, or some such suitable indicating device shall be used.
3. Do not approach closer than one foot to any electrical circuit or any electrical equipment where the circuit voltage is below 7,500 volts and which has exposed

live metal parts, except to accomplish a particular mission with respect to the circuit or equipment. Where the circuit voltage exceeds 7,500 volts, maintain clearances as tabulated in section 18221, paragraph 4 c (3).

5. First Aid

a. RESUSCITATION. Electrical workers are to know the procedures of the back-pressure, arm-lift (Holger-Nielson) and the pole-top methods of resuscitation, which are to be used when artificial respiration is necessary. Employees not familiar with these methods shall arrange with the Safety Officer to obtain the necessary instruction without delay. The electronics officer or other cognizant officer shall require personnel engaged in electrical work to demonstrate their practical knowledge of the application of artificial respiration. He is to arrange for additional training, if necessary, so that workers may attain proficiency.

b. ATTENDANT. A man who is qualified in administering first aid for electric shock shall be immediately available whenever work is being performed on live circuits.

18102 SAFETY FROM FIRE

1. Preventing Fires. General cleanliness in the entire area is essential for the prevention of fires. In addition, the following requirements are particularly applicable in an area where work with electricity is being carried on:

a. AVOIDING USE OF FLAMMABLE CLEANING FLUIDS

1. Gasoline, benzene, ether, and similar flammable cleaning fluids shall never be used on either energized or deenergized electrical apparatus.
2. Alcohol shall not be used for cleaning equipment as it damages most types of insulating varnishes.
3. Alcohol shall never be used for cleaning near electrical equipment from which a spark might be received.
4. Because of its highly toxic vapors, carbon tetrachloride shall never be used as a cleaner.

b. KEEPING MACHINERY CLEAN. Oil, grease, carbon dust, etc. can become ignited by electrical arcing. Machinery is to be kept absolutely clean and free of all such deposits.

c. **AVOIDING OPEN FLAMES.** Lighted matches or other open flames shall never be used in confined spaces because of the danger of explosions and fires.

2. Fire Fighting. In the event of a fire, the following procedures are to be carried out:

a. **RULES APPLYING TO ALL FIRES**

1. Call the Fire Department.
2. Immediately deenergize the circuit or equipment affected. If standby circuits and equipment are available shift the load to them.
3. Control the fire as far as possible with the correct type of firefighting equipment until the Fire Department arrives. Firefighting equipment must be kept readily available at all times.

b. **RULES APPLYING TO SPECIFIC SITUATIONS**

(1) *Fires Near Standpipes.* If an electrical fire occurs at a location where standpipes are available, the standpipes should be manned only by experienced fire-fighting personnel who are familiar with that equipment.

(2) *Cable Fires.* In case of cable fires in which the inner layers of insulation, or insulation covered by armor, support combustion, the only positive method of preventing the fire from running the length of the cable is to cut the cable and separate the two ends.

c. **FIREFIGHTING EQUIPMENT.** Extreme care shall be taken to select the proper type of equipment to combat electrical fires. The preferred extinguisher for electrical fires is the Class C extinguisher. The stream from this extinguisher is nonconductive and can be directed against energized circuits without danger of shock. Fire extinguishers ordinarily used for electrical fires are the carbon dioxide, dry chemical, and vaporizing liquid types. (See chapter 2 for details.) The latter type is never to be used in confined spaces or in large quantities. If it is necessary to use salt water extinguishers against electrical fires, extreme care must be observed to avoid shock. The same danger exists in lesser degree if fresh water is used.

3. Inspection Before Current Is Restored. If the electrical wiring or apparatus has been affected by fire a careful inspection must be made before the current is turned on in the building.

18103 INSPECTION AND MAINTENANCE

1. Personnel Responsible. Inspection and maintenance work on electrical equipment shall be performed only by qualified and authorized personnel.

2. Inspections

a. **INSPECTION OF EQUIPMENT.** Electrical appliances and equipment must be inspected for adequacy of safety features periodically (the exact periods of time to be determined by the safety officer or other qualified person), for damaged insulation and loose connections. Appliances and equipment found to be defective shall be removed from service.

b. **INSPECTION OF SAFETY DEVICES.** Periodic inspections and tests are to be made on safety devices to ensure that they are functioning properly.

3. Overhauling Machinery. Unauthorized modifications to electrical wiring and equipment shall not be made, nor shall authorized modifications be made by other than qualified personnel.

4. Cleaning. Electrical and electronic equipment must be kept clean at all times to ensure proper performance. The following precautions are to be observed when cleaning:

a. **SAFETY IN USE OF CLEANING EQUIPMENT**

1. Brushes, dusters, brooms, or other such articles which may be used within four feet of or on electrical equipment having exposed or current-carrying parts shall not themselves contain any exposed metal parts.
2. If a vacuum cleaner is necessary, use only one with a nonmetallic hose and an adequate dust receiver.
3. Use sandpaper and files only upon competent advice.
4. Do not use solvents unless absolutely necessary. When solvents are necessary, use only the smallest possible quantity of approved solvent.

b. **BLOWING OUT EQUIPMENT.** Use only rubber or insulating hose in airlines for blowing out equipment. Use no more than 50 pounds of pressure to avoid damage to the insulation. Be sure the air is free from water. Never turn compressed air on yourself or others, since it can cause serious injury.

Section 2

WORKING WITH ELECTRICITY

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Subsection A

ELECTRICAL EQUIPMENT

18201 SPECIAL WARNINGS TO PERSONNEL

Care shall be taken in handling all tools, loose metal parts, liquids, etc. which it is necessary to use in an area where there is electrical equipment or electrical work being done. The following general rules shall apply:

1. Danger From Metal Objects

1. Personnel shall exercise care when it is necessary to walk above open electrical equipment or exposed wires to insure against dropping or loss of metallic objects attached to clothing.
2. Tools of magnetic material can be pulled into contact with dangerous circuits when these tools are used in the vicinity of magnets associated with magnetrons in radars. Care must be taken to avoid this hazard.

2. Danger From Foreign Objects. Storage or insertion of foreign articles in or near switchgear, control appliances, panels, etc., is forbidden.

3. Danger From Energized Equipment. Personnel required to work on energized equipment shall be familiar with the precautions in subsection B, article 18221.

18202 SECURING SWITCHES PRELIMINARY TO WORK

1. Deenergizing Circuit. In general, all utilization circuits shall be deenergized before any work is performed on them. When it is necessary, due to existence of emergency conditions, to work on such circuits, precautions cited in

section 18101 herein shall be observed. When electrical equipment is to be worked on, it shall be disconnected from the source of supply by opening main or branch supply switches, circuit breakers, or cutouts so as to completely eliminate the possibility of current flowing to the equipment. Switches, circuit breakers, or cutouts opened for this purpose shall be secured in the open position, shall have tags attached, and only the individual placing the tag shall remove it and reenergize the circuit.

2. Tagging. After securing, the switches shall be tagged with a "Hold" card bearing the following words: "This circuit was ordered open for repairs and shall not be closed except on direct orders of the undersigned." The "Hold" card is to be signed and dated, usually by the person directly in charge of the work. If the card cannot be seen clearly a red light is to be used to illuminate it.

3. Removing Tag or Lock. When the work has been completed, the tag is to be removed by the same person. Nobody should remove another person's tag. If the switch has been locked it shall be unlocked and the circuit restored by the person retaining the key.

4. Tagging by More Than One Party. When more than one repair party is engaged in the work, a signed and dated tag for each party shall be placed on the supply switch. The individual who tagged this switch for his party is to remove only his own party's tag when the work has been completed and it has been determined that all persons are in the clear.

18203 GROUNDING OF METAL PARTS

1. Where Necessary. Metal cases, bases, frames, and other metal parts of electrical equipment, appliances, machines, fixtures, and fittings, except such minor items as portable floor, desk, or table lamps, household appliances, and items such as wall clocks, portable fans, electric shavers and hair curlers, shall be grounded. Where inherent grounding is not provided by the mounting arrangements, ground connections shall be provided to ground the frame, enclosure, or support of permanently installed electrical equipment. Semiportable equipment which is normally used at a fixed location shall also be grounded. Portable electrical equipment in conductive housings shall have adequate grounding. The total resistance from the enclosure to the positive ground to which it is connected shall not exceed 25 ohms. Metal used in building structures and particularly in wooden structures shall be grounded.

2. Grounded-Type Plugs and Receptacles

a. USE. Navy specifications for portable tools require that the electric cord for such tools be provided with a distinctively marked ground wire in addition to the conductors for supplying power to the tool. The end of the ground wire within the tool shall be connected to the tool's metal housing. The other end shall be connected to a positive ground. For this ground connection, specifically designed grounded-type plugs and receptacles, which automatically make this connection when the plug is inserted in the receptacle should be used. These grounded type receptacles shall be installed for all power outlets. When installed, they shall be used with the grounded type plugs to ground portable tools and equipment. If grounded-type receptacles have not yet been installed, they shall be installed as soon as possible. Portable tools not provided with the grounded-type plug and miscellaneous portable electric equipment which does not have a cord with a ground conductor and grounded plug shall be provided with a 3-conductor cord with a standard Navy grounded-type plug. The ground wire shall be connected to a positive ground and the total resistance

from the tool enclosure to the ground to which connected shall not exceed 25 ohms.

b. CONNECTING PLUGS AND CORDS. Care must be exercised in connecting the plugs and cords. The grounding conductor of the cord shall be connected to the ground contact of the plug at one end and to the metal equipment housing at the other end. The cord shall be arranged so as not to create a tripping hazard. If the conductor which is connected to the metallic equipment housing should be inadvertently connected to a line contact of the plug, a dangerous potential would be placed on the equipment casing, which might result in a fatal shock to the operator. If the cord is pulled loose from the plug only qualified electricians shall repair it.

3. Other Types of Plugs and Receptacles. If grounded-type plugs and receptacles have not been installed in the spaces where a portable tool is to be used, other types of plugs and receptacles may be used, only if a separate ground wire is connected between the tool housing and a positive ground. When the tool cord does not include an extra wire for grounding, an additional insulated wire should be connected between the metal housing of the tool and ground. If the tool housing has two or more conducting parts which are not electrically connected, each part shall be connected to the ground wire. Connections of the ground wire to the tool housing and to the ground shall be by means of screws or bolts. Employment of spring clips for either end of the grounding wire is prohibited.

4. Other Means of Grounding. When the ground connection is to be made by means other than a contact in the plug and receptacle, care shall be taken to secure a good contact between the ground wire and the metal by scraping away paint to provide a clean surface. The ground connection shall be made before inserting the power supply connecting plug, and the plug shall be pulled out before removing the ground connection. Frequent inspection of all the connections in portable electric tools shall be made to assure that the supply cord and its connections within the tool are suitably insulated and that the ground connection is intact.

5. Grounds on Power Lines. Except in an installation where local power conditions require a grounded supply line as a normal operating condition, the power shall be removed from equipment immediately when the power line shows a ground. The circuit shall not be energized until it has been determined that the ground is not in the equipment.

6. Grounding of Metal Fittings on Masts and Spars. Metal fittings installed on wooden masts and wooden spars of ships shall be effectively grounded by metallic strips, preferably copper $1\frac{1}{4}$ inch wide by not less than $1/16$ inch in thickness. The grounding of isolated metal parts where feasible or the bonding of parts together where grounding is not feasible is helpful in reducing fire hazards.

7. Wooden Buildings. In wooden buildings, care should be exercised to run all electric wiring at least four feet from all down-leads of any lightning protective system. All steel masts, metallic gutters and down spouts, steel beams, columns, and other metallic members of appreciable mass should be grounded.

8. Discharging Machines to Ground. The charge retained by electrical equipment when it is secured is, in certain cases, sufficient to cause a severe shock. Before the terminals of an apparently dead piece of equipment are touched, the equipment should be discharged to the ground by momentarily connecting the terminals together and to ground. Capacitors, reactors, lightning arresters, transformers, and similar equipment with high values of capacity or inductance are particularly dangerous and should be discharged twice at intervals of not less than 15 seconds if the highest possible level of personal safety is to be attained.

18204 PORTABLE ELECTRICAL EQUIPMENT

Electrically powered portable tools such as drills, grinders, scaling hammers, and sanders may become sufficiently damaged during normal use to cause electrical shock to the user. Cases are recorded in which shock has been fatal. Shipboard conditions are specially conducive to increasing the severity of a shock because the person affected is usually in contact with the ship's metal structure and because the dampness often present in the user's

clothing lowers electrical resistance. All personnel who use portable electric tools are cautioned to make certain that a proper ground connection is provided. (See article 18203 for grounding precautions.)

1. Portable Cables. Portable electrical cables shall be carefully selected and maintained. Spliced portable cables are extremely dangerous and shall never be used unless an emergency warrants the great risk involved. Portable cables should be of sufficient length that they will not be subjected to longitudinal stresses or need to be pulled taut to make connections. Current-carrying capacity should be ample for the expected power demand. Portable cables should be checked frequently while in service to ascertain degree of heating. Any cable which feels more than comfortably warm to the bare hand placed outside the insulation should be checked immediately for overloading. Interconnections between lengths of portable cable shall be made only on approved connection blocks or by other approved fittings which shall be suitably insulated and enclosed to eliminate all possible hazards from fire or shock to personnel.

2. Portable Electric Megaphones. After Type PAE-1 and Type PAE-2 portable electric megaphones have been charged, before the megaphone cable is attached to the amplifier, the following precautions are to be observed:

1. Remove the cover of the amplifier case for five minutes to dissipate hydrogen gas that may be present.
2. After the ventilation period, unlatch and swing back the amplifier. Check the gasket on top of the manifold to be sure that the hole in the gasket is in line with the hole in the manifold. If it is not, align the gasket and secure it with rubber cement and two small nails.
3. Inspect the rubber tube to be sure it is in good condition and that it is fully in place on its fittings.
4. Inspect the hole of the external vent to be sure that it is not clogged.
5. Replace the battery, secure the amplifier, and replace the amplifier case.

3. Portable Appliances. No electric fan may be operated without the fan blade guard in place.

Commercial household appliances may not be operated aboard any Naval vessel without prior approval of the engineer officer and authorization of the executive officer. No commercial household appliance shall be operated in the Naval Shore Establishment which has not been approved by the Underwriters Laboratories.

18205 INSTALLED EQUIPMENT

1. **Searchlights.** The following precautions are to be observed in connection with searchlights:

a. OPERATION OF THE ARC

1. Do not look directly at the arc; use the peep sight or the arc viewing screen on the side of the drum.
2. Keep the drum tightly closed during operation of the arc.

b. **WORKING ON SEARCHLIGHTS.** Before performing work on searchlights observe these precautions:

1. Lock the searchlight securely in train and elevation before opening the front or rear door of large searchlights.
2. Be sure the power supply to the shutter is off before opening the front door or doing any work inside the drum.
3. Be sure the locks are disengaged in train and elevation and the searchlight is free to move before attempting to train or elevate the light, either electrically or manually.
4. Deenergize the control circuit and disengage the clutches on a searchlight with remote electrical control.

c. HANDLING OF CARBONS

1. Be sure the lamp switch is off before starting to change carbons.
2. Do not start the arc unless the carbons are properly placed and are firmly gripped by the feed rollers.
3. Do not close the main switch when the carbons are touching, except in lamps where a hinged negative head is used to strike the arc.
4. Be sure the positive carbon does not touch its nose cap. Keep the positive nose cap free from dirt and carbon dust deposits.
5. When using a nose cap reamer, release the contacts and feed rollers and never allow

them to come into contact with the reamers.

2. **Series-wound Motor.** A series-wound motor on a direct-current machine should not be started unless the motor is attached to a substantial load. Otherwise the motor may attain dangerous overspeeds.

3. Cable

1. Electrical power cable is not to be used to support chain falls, lifting tackle, or weights of any kind.
2. Scaling, chipping, and wire brushing shall not be performed on power or lighting cable.
3. Before welding or drilling bulkheads or decks, a thorough inspection shall be made of the opposite bulkhead. Cable that might be affected shall be removed from the immediate area by competent personnel.
4. Power cable is not to be used as ladder rungs for climbing.
5. Cable identification tags must not be removed or painted.
6. Work on power, lighting, or telephone circuits shall not be performed by other than authorized and qualified personnel. This requirement applies also to packing glands (terminal or bulkhead tubes) used in connection with these circuits.
7. All electrical conductors shall be considered to be carrying current until it has been established beyond doubt that they are dead. Test lamps shall not be used on circuits expected to be operating at more than 150 volts.

4. Fuses

1. Fuses are to be removed and replaced only after the circuit has been completely deenergized.
2. Whenever practicable, a circuit should be checked before replacing a burned out fuse, as the trouble is usually indicative of a circuit fault.
3. Fuse pullers made of insulating material shall be used for removing and replacing most fuses. (This includes all except those mounted in plug-type fuse holders, which are easily removed by unscrewing the plugs.)

4. A blown fuse shall be replaced by a fuse of the same ampere capacity. Insertion of metal discs, coins, etc. in back of plug fuses, or the shorting out of cartridge type fuses, is strictly prohibited.
5. Where removable fuse links are used, only one link of correct rating is to be used for each fuse.
6. Special precautions shall be taken to in-

sure that the secondary of a current transformer is not opened or disconnected until it has been positively determined that the primary circuit has been de-energized. This precaution shall be observed regardless of the operating voltage of the circuit in which the current transformer primary is placed.

Subsection B

Electrical Circuits

18221 WORKING ON ENERGIZED CIRCUITS

1. When Permissible. Repairs are not to be made on energized circuits except in emergency. A circuit must be considered energized until it has been checked and the switch opened and tagged. See articles 18202 and paragraph 3 below.

2. Personnel Involved

a. REQUIREMENTS FOR WORKERS. Repair work on an energized circuit shall be performed only by personnel fully aware of the dangers involved, including those dangers encountered on the so-called lower potential circuits (below 600 volts) as well as those on higher voltages (above 600 volts).

b. SUPERVISORS. All work shall be supervised by qualified technicians or experienced communications or electronics material officers.

c. STANDBYS. Men should be stationed by circuit breakers or switches, and telephones should be manned, if necessary, so that circuits or switchboards can be immediately deenergized in case of emergency. A man qualified in first aid for electric shock shall stand by during the entire period the work is being performed.

d. INSULATING WORKERS FROM GROUND. Persons performing the work shall be insulated from ground and shall avoid possibility of contact with grounded hand rails and exposed metal deck or equipment frames.

3. Checking the Circuit. When a circuit is to be checked, the live lead side should first be tested with a voltmeter, voltage tester, or test lamp. The dead side should then be tested with the same device, and the live side tested again. This is to determine whether the testing device is in good condition. When voltages of 1,000

volts or more are to be measured the following precautions are to be observed:

a. PREPARING THE EQUIPMENT

1. Deenergize the equipment to be tested.
2. High voltage capacitors and the terminals to which the test equipment is to be connected shall be discharged with a suitably insulated shorting or grounding bar.
3. Secure on the desired test points the test leads capable of carrying high voltage.
4. Ascertain that the test equipment controls are set correctly for testing high voltages.
5. Withdraw from the equipment under test, making sure you are free from leads and in a proper position for taking correct meter readings.

b. TAKING THE MEASUREMENTS

1. Do not take the measurements directly, as by means of flexible leads or probes.
2. Assign the responsibility of energizing the equipment to an assistant standing by the switch.
3. Do not touch the test instruments while the power is on.
4. After taking the reading, deenergize the equipment.
5. Discharge the high voltage capacitors and the terminals to which the test equipment is connected before removing the test leads.
6. Repeat the above precautions for each measurement, as applicable.

4. Precautions for Specific Voltages. Although many of the precautions listed for work with specific voltages relate to line work and should be studied in conjunction with subsection C, the over-all safety measures relate to *all work on*

live circuits and for that reason are included here with other general working rules.

a. **LOW VOLTAGE WORK, 0 TO 600.** Conductors and equipment operating at 600 volts or less may be worked upon alive if the following requirements are met:

1. Adjacent live or grounded conductors and equipment shall be covered with insulating material or approved rubber protective equipment.
2. Two men should work together, particularly when work is done on energized parts carrying more than 150 volts, in wet weather, or at night. When working on energized lines a man should not change his position on a pole without first informing others working nearby.
3. Bare or exposed places on one conductor must be taped or covered before another conductor is exposed.

b. **INTERMEDIATE VOLTAGE WORK, 600 TO 3,000 VOLTS**

(1) *Testing Voltage.* All conductors and equipment must be considered as carrying current and as being alive until it has been determined beyond doubt that they are dead. When positive proof as to whether a conductor or a piece of equipment is energized cannot be established by a visual check, an approved voltage detector is to be used. Before being used, the detector must be checked on a conductor that is known to be alive and a positive indication noted. This check on a known live conductor must be repeated after the test on a dead conductor has been made. When it is not possible to recheck the voltage detector on a live conductor, two voltage detectors should be used, one as a check against the other.

(2) *Insulating Equipment.* When work is to be done on or within reach of conductors or equipment operating between 600 and 3,000 volts, energized and grounded conductors or equipment within reach must be isolated with suitable barriers or covered with rubber hose line, insulator hoods, line protectors (pigs), or blankets. If it becomes necessary for the workman to change his working position he must cover or barricade any energized or grounded conductors or equipment that will be within his reach in the new position.

(3) *Deenergizing.* When conditions permit, the section of the line being worked on shall be deenergized by opening the sectionalizing switches, and grounding.

c. **HIGH VOLTAGE WORK, 5,000 VOLTS AND OVER.** Lines and equipment operating at 5,000 volts or over must be deenergized and grounded (see article 18203) before work is started, except for emergency repairs on overhead lines, which may be worked on alive with approved live-line tools.

(1) *Precautions When Circuit is Deenergized.* Work on deenergized circuits must be done between two sets of grounds, one set to be placed on the first pole or structure toward the source of energy and the other on the first pole toward the load. When grounds are to be attached, the ground connection must be made first. When grounds are to be removed the ground connection must be broken last.

(2) *Using Live-Line Tools.* The following precautions must be taken when live-line tools are used:

1. Work with live-line tools shall not be performed when rain or snow is imminent or falling, or when heavy dew, fog, or any form of excessive moisture is present.
2. When working on lines energized at more than 5,000 volts, use approved hot-line tools without rubber gloves. Handle series street lighting circuits supported on arms with other lines energized at more than 5,000 volts, the same as the power supply conductors.
3. No more than one conductor may be worked on at a time with live-line tools.
4. Live-line tools must be kept dry and free from dirt. Tools which have been subjected to damp weather must be thoroughly dried and tested before being used again.
5. Live-line tools being transported on line trucks shall be stored so as to prevent damage to them. Waterproof canvas bags may be used for this purpose. A compartment equipped with padded hooks or binds may be built into the truck for this purpose.

(3) *Body Clearance for High Voltage Work.* A minimum body clearance from energized

lines and equipment shall be maintained by men working on or around electrical equipment of high voltage, as shown in the following table:

Operating Voltage (Kilovolts)	Minimum Distance (Feet)
5 to 7.5.....	1
7.5 to 12.....	2
12 to 33.....	3
33 to 66.....	4
66 to 132.....	5
132 to 220.....	8

18222 WET AND DRY CELL BATTERIES

1. **General Precautions.** The following general safety precautions are to be observed in connection with storage batteries and dry batteries:

1. Keep flames and sparks away from the vicinity of batteries.
2. When using tools around batteries exercise care not to short circuit battery terminals.
3. Never open batteries except in well-ventilated spaces and only in extreme emergencies if the room temperature is above 125 degrees F.
4. Keep the temperature of the battery compartment below 95° F., if possible.

2. **Ventilation of Storage Batteries.** The following precautions are to be observed in connection with the ventilation of storage batteries:

1. Be sure to ventilate a battery compartment which has been sealed before turning on the lights, making or breaking electrical connections, or performing any type of work in the compartments.
2. Make certain the ventilating apparatus of a battery compartment is operating properly before starting a charge.
3. Stop the charge if ventilation is interrupted, except in an emergency. Do not resume the charge until the ventilation has been restored.
4. Avoid sparks when removing or replacing batteries in compartments which may contain fumes.
5. Use only tools with insulated handles for removing and replacing batteries.
6. When using batteries with one terminal grounded, disconnect the grounded terminal

before removing the battery and do not reconnect it until the battery has been replaced.

3. **Charging Storage Batteries.** The following precautions are to be observed when batteries are to be charged:

1. Do not make repairs to the battery connections while its circuit is energized.
2. Turn off the charging current before batteries are connected or disconnected on the charging line.
3. Be extremely careful to keep open flames and sparks away from batteries while they are being charged. The hydrogen given off during this operation is highly flammable and may cause flash fires and explosions.

4. **Handling Battery Acid.** When handling battery acid, personnel are to observe the following precautions:

1. Never pour the water into the acid; the acid must always be poured slowly into the water.
2. Guard the eyes and skin from splashing acid.
3. Do not store sulfuric acid in places where freezing temperatures are possible.
4. Keep the electrolyte at a level above the tops of the separators.

5. Using Type 19026 Dry Batteries

a. **SHOCK HAZARD.** The 300-volt B Section of the Navy Type 19026 pack battery is capable of giving a very serious, and even fatal, shock upon contact. Extreme care must be taken not to come into contact with the terminals of this battery or of any high voltage battery.

b. **DISCONNECTING THE BATTERY.** When this type battery is to be disconnected from the operating apparatus, the current flow shall be stopped before disconnecting the plug. It is possible for sufficient hydrogen gas to accumulate in this battery to produce a serious explosion if ignited, and a spark produced by pulling the plug from the socket while the current is flowing is liable to ignite accumulated gas.

18223 SWITCHES AND CIRCUIT BREAKERS

Switches and circuit breakers perform the same function, and the precautions to be taken

with them overlap in many details. The following precautions shall be taken as they are applicable to the particular circuit:

1. **Installation of Switches.** Switches shall be installed so as to minimize the danger of accidental operation. Where practicable, they shall be installed so that gravity cannot operate them. When this is not practicable, they shall be equipped with suitable latches to prevent accidental closing. Except where absolutely necessary, switches are not to be installed in locations where explosives or flammable vapors exist. When they are installed in these locations, they should be of the special explosion-proof type. Only safety-type switches shall be permitted at machines.

2. **Operating Switches.** A workman shall not operate any system switch, circuit breaker, or other disconnecting device until he is instructed to do so by proper authority and is thoroughly familiar with the equipment involved. When operation has been authorized, the following precautions shall be taken:

a. PRELIMINARY PRECAUTIONS

1. When maintenance or repairs at a Naval activity involve switching operations which may affect the serving utility's system, the station safety engineer must notify the system operator of the utility, so that prearranged emergency measures may be followed if the utility's circuit breakers trip out.
2. When local branch circuits which feed moving or rotating parts are to be energized, men near moving parts must be notified that the circuit is to be energized. This is particularly important in cases where rotating antennas are energized. Where the men are not visible from the control station, a safety watch shall be maintained with adequate means of communication between the station and the watch.

b. SAFETY DURING WORK

1. During the time the electrical foreman is switching, the men on the job shall not follow him or congregate where the switching is being performed.
2. Switch handles should always be moved to definite positions.

3. Before doing any switching on a regulated feeder, workmen should be sure that regulators are off the automatic position and set in the neutral position.

c. SAFETY WITH SPECIAL TYPE OF SWITCHES

(1) *Outdoor Disconnecting Switches.* Outdoor disconnecting switches shall not be operated without the disconnect pole provided for that purpose.

(2) *Air-Break Switches.* Each time an air-break switch is opened, a check shall be made to make certain that all contacts are actually open and safe clearance is obtained on all three phases. The position of the operating handle is not to be depended upon as evidence that the switch is open.

3. Safety with Circuit Breakers

a. PRECAUTIONS PRELIMINARY TO WORK. Before any work is done on a circuit breaker the following precautions shall be taken:

1. All control circuits to which it is connected shall be deenergized.
2. Draw-out circuit breakers shall be switched to the open position and removed before any work is done on them.
3. Disconnecting switches ahead of circuit breakers shall not be opened until after circuit breaker is tripped to open position. No work shall be done on the opened circuit breaker until all isolating switches protecting it also have been opened.
4. Where disconnecting switches are not provided to isolate circuit breakers, the supply bus to the circuit breaker shall be deenergized on all circuits where the voltage is in excess of 150 volts. On circuits where the voltage is below 150 volts, work may be done under emergency conditions with the circuit breaker energized by strict adherence to the provisions of regulations for working on energized circuits contained in article 18221 herein.
5. Before working on an oil circuit breaker, workmen must be sure that the breaker cannot be opened or closed automatically. When possible, it should be in the open position or have the operating mechanism blocked.

b. **OPERATING CIRCUIT BREAKERS.** When operating circuit breakers, follow these precautions:

1. Use only one hand.
2. Keep the hands clear of parts other than operating handles.
3. Touch only one breaker handle at a time.
4. Close isolating or back-up switches before closing circuit breaker to restore service or to energize circuits.
5. Trip circuit breakers before opening switches.
6. Keep the face turned away while closing circuit breakers.
7. A circuit breaker shall not be prevented from performing its normal function by short circuiting or blocking out interlocking, overload, or other protective devices, except for purposes of authorized test work.
8. Never stand over a circuit breaker while the power is on.

c. **CLOSING CIRCUIT BREAKERS.** Before a branch or equipment circuit breaker or switch is closed, it should be determined that:

1. the circuit is ready, equipment connected to it is in condition to be energized, and all clearance has been given up and all tags removed;
2. men working on the circuit have been notified that the circuit is to be energized and they are in the clear;
3. circuit protective devices are in good working condition.

18224 WORKING ON TRANSFORMERS

Precautions of this section are limited to the equipment used in the ordinary electric circuit. For further details concerning capacitors and condensers, personnel are referred to the precautions in 18303.

1. Protection of Personnel at Work

a. **REMOVING FUSES.** When removing transformer fuses, the workman must wear rubber gloves with leather over-gloves. This applies also to fuses which are being replaced by means of switch sticks equipped with fuse tongs

or by means of regular fuse tongs, where the circuit voltage exceeds 150 volts.

b. **STANDING ON LIVE TRANSFORMERS.** Workmen must not stand on top of energized transformers, regardless of voltages, except in extreme emergencies, and then only with the full knowledge and consent of the man in charge of the work crew. When such procedure is followed, the transformer cover shall be first covered with a rubber blanket, protected in turn with a rubber bag. Standing on top of a transformer when wearing climbers is strictly prohibited under any circumstances whatsoever.

c. **RAISING AND LOWERING TRANSFORMERS.** Workmen must not stand beneath transformers which are being raised to, or lowered from, any overhead structure. While transformers are being raised or supported with blocks, men on the pole or structure must take a position above, or well in the clear of the transformer.

d. **PROTECTION AGAINST GASEOUS FUMES.** Large transformer case interiors are not normally ventilated and very frequently contain poisonous or explosive fumes. No work should be done inside any transformer case until provision has been made to continually exhaust such fumes while the work is progressing. Men working in transformers should be instructed to report any feeling of ill effects from fumes or gases immediately, and shall be ordered out of the immediate area until they have recovered.

2. Care of the Transformer

a. **GROUNDING TRANSFORMERS.** The case of all transformers shall be grounded to a positive ground. On systems operating with one conductor grounded, the case shall be connected to the ground conductor at the transformer.

b. **TAKING PARALLELED TRANSFORMER OUT OF SERVICE.** When a paralleled transformer is taken out of service the secondary phase lead or leads must be disconnected before the primary cutouts are opened. The secondary neutral or ground connection should not be disconnected until the primary cutouts have been opened.

Subsection C

LINE CONSTRUCTION AND DISTRIBUTION

18241 SCOPE

This subsection deals only with equipment and working precautions specifically applicable to line work. *Of primary importance to the safety of all workmen in the area is the employment of maximum precaution in working on circuits and equipment operating above 600 volts.*

18242 EQUIPMENT USED IN LINE WORK

1. **Transmitting Tools and Equipment.** Tools and other materials shall not be thrown or dropped down to personnel working on another level. They are to be raised or lowered by means of handlines or canvas toolbags or buckets. Workmen should stand clear when tools and other materials are being raised or lowered. They should not walk or stand under a load which is not properly placed and secured.

2. Safety in Using Tools

a. **USING PORTABLE ELECTRIC TOOLS.** The cases of all portable electric tools which are held in the hands while being operated shall be grounded regardless of their voltage. (See subsection A, article 18203). Care must be taken that the ground wire is not disconnected or broken.

b. **SKINNING KNIVES.** Skinning knives shall not have sharp points. Knives with metal shanks extending through the handles shall not be used.

c. **PLIERS.** Metal tool handles shall be covered with rubber insulating tape. Use of plastic or cambric sleeving or friction tape alone is prohibited for this purpose.

d. **FLASHLIGHTS.** No flashlights designed for holding in the hand shall be used which have any metal parts exposed. Use of friction tape or other tape to cover exposed metallic parts in order to circumvent the intent of this regulation is strictly prohibited.

3. Proper Use of Protective Devices

a. ROPE

1. Rope which is used on or near energized equipment is to be free of metal strands.
2. Rope shall be replaced when the strands become frayed.

3. Tape, string, or marlin cord shall not be used to repair rope.
4. Rope is to be kept clean of foreign articles such as bits of solder which could cut the hands or rubber gloves.
5. If it is necessary to take hold of a rope passing through a snatch block or around a niggerhead, the hands should be kept at a safe distance from block or niggerhead.
6. Uncoiled rope or wire shall never be left unguarded where it creates a tripping hazard.
7. Safety lines, handlines, and other ropes or wire are not to be hung from a pole in such a manner that they can in any way interfere with traffic.

b. CLIMBERS

1. Climbers are *not* to be worn when workers are working on the ground or on a ladder, standing on a rubber blanket, moving from job to job, or riding in a vehicle.
2. Climbers shall not be used after the gaffs are worn to less than 1¼ inches measured on the inside.
3. Gaffs should never be sharpened on the underside, except to make the shoulder. Such sharpening changes the angle to which the gaffs are set. When this angle is changed, the climber is unsafe for use. Because of the danger of removing the temper from gaffs, care should be taken to keep the gaffs cool during sharpening operations.
4. Climbers equipped with extra-long spurs shall be used to climb poles which have not been barked or skinned.

c. BODY BELTS AND SAFETY STRAPS

(1) Construction

1. Body belts or safety straps which have been stitched across the width shall not be used.
2. Tape shall not be used to mend, protect, or mark belts or straps.
3. A leather thong with a wooden or fiber bar shall be used for holding tape which is to be used by the workman. The use of chains for holding tape is forbidden.

4. A leather pouch must be used on the body belt for holding pliers. Wire keepers are prohibited.
5. Snaps on safety straps must be of drop-forged steel.

(2) *Inspection and Repair.* Body belts and safety straps are to be examined by the foreman during regular tool inspections. If there is any doubt as to the safety of a belt or strap it should be repaired or replaced at once.

(3) *When Worn.* A workman is to wear his safety strap when he is working on a pole, ladder, or structure.

(4) *Placing the Safety Strap*

1. The safety strap is to be placed around a part of the structure which is of sufficient strength to sustain a man's weight and his equipment and shall be so placed that there is no danger of its slipping. (That is, it must be at least eighteen inches from the end of the part on which it is fastened.)
2. Where possible, the strap should be placed under an arm or brace.
3. It must not be placed around any part of a structure which is being removed.
4. The strap shall rest flat against the surface without twists or turns.

(5) *Securing the Strap*

1. While a workman is in a working position a snap must be placed in *each* D-ring. (When a strap is being worn but not in use both ends of the strap shall be snapped into the same D-ring.)
2. When a workman is attaching the safety strap to the D-ring, he should not rely on the "click" of the snap-tongue as an indication the fastening is secure. Before placing his weight on the strap, he should determine that the snap and the D-ring are properly engaged. The tongue of the snap should be away from the worker's body when engaged in the D-ring.
3. To prevent the snap from becoming disengaged from the D-ring, a workman should avoid pressure on the snap-tongue when leaning against equipment such as arms, pins, braces, wires, etc., which might cause the snap to open.

(6) *Avoiding Damage to Strap.* While

climbing, a workman should exercise care to avoid his safety strap catching on pole steps. When climbing past a fellow employee whose safety strap is in place around the pole, he should be particularly careful not to damage that strap.

(7) *Storage of Belts and Straps.* Belts and straps are not to be stored where they are subject to damage from excessive heat or dampness.

d. **INSULATORS.** Insulators should be lifted by the tops to avoid cutting rubber gloves or hands on sharp edges of the petticoat. They should not be screwed down too tightly, as the tops may break off, creating sharp edges.

4. **Handling Hot Solder and Compounds.** The following precautions are to be observed in the handling of hot solder and compounds:

1. Keep furnaces far enough from manhole openings that there will be no possibility of hot metal or compound spilling into the manhole.
2. Never place a cold or wet ladle or other object in molten solder or hot compound.
3. When raising or lowering solder or compound, secure the pot with a hook and steady the line so that the pot will not swing excessively.
4. Stand clear when solder and compound are being raised or lowered.
5. Work from above or to one side while soldering.
6. Wear goggles when soldering large joints and tinning lugs and T connections.

18243 HANDLING WIRE

1. Handling Pay-Out Reels

1. Wire must be removed from the underside of reels.
2. When the pay-out reel in a truck is being used to string wires near energized wires, the truck must be grounded.
3. When stringing wire near other wires, the man tending the pay-out reel must wear rubber gloves and should not allow any part of his body to come in contact with the wire being strung. When possible he should stand on dry lumber or other insulating material.

4. When a brake is to be used on a pay-out reel to prevent slack in the wire being strung, the brake should be applied to the rim of the reel and on the side opposite the direction in which the wire is being pulled. A crossarm or side arm may be used as a brake.
5. When work is done on jumpers, especially those that are long, the loose ends are to be held in the clear. If necessary, there must be a man at each end to hold them.
6. The ends of the tie wires must be kept coiled while they are being installed or removed in order to prevent the possibility of their accidentally coming in contact with an energized conductor.

2. Making Connections

1. When possible, connections should be made when wires and other equipment are dead. Only the final connection should be made to the live conductor.
2. The ground connection must never be opened at the ground-pipe or at the ground bus-bar unless it has been disconnected first at the point of contact with the equipment it is intended to ground. This will prevent the possibility of an accident if the ground wire or ground bus-bar should be alive.
3. When a ground wire on a pole is to be connected, the ground-pipe connection must be made first.

3. Removing Wires

1. Before a primary or secondary wire is removed, a workman must test it to determine whether it is dead. The man in charge shall recheck the wire to be sure it is dead.
2. A span of wire that is to be removed must be treated as alive, must have a rope attached to each end, and must be lowered only one span at a time.
3. When the take-up reel is used to coil wires being removed from line arms, the wires must be treated as alive. Wires being removed in this manner are to have a rope attached to the end farthest away from the take-up reel. The man tending the reel must wear rubber gloves.

18244 WORKING ON POLES, SCAFFOLDS, STAGING, AND TREES

1. Weather Requirements. Routine maintenance and construction work for which there is no emergency requirement should not be undertaken during severely stormy weather. Work on electrical distribution poles and towers should not be done during any wet weather conditions except for purposes of restoration of service in an emergency in which case, extreme care shall be taken to avoid possibility of electric shock due to wet or damp clothing or tools. On routine work, suspension of activity should be planned in accordance with prevailing and changing weather conditions so that power and communication lines may be safely left for continued operation until storms have abated and conditions are safe for this type of work.

2. Meeting Obstructions in Digging. When obstructions are encountered in digging operations the workman is to notify the man in charge immediately, who will arrange for the necessary precautions against such hazards as contacting live cables.

3. Securing Elevated Working Positions. When working in elevated positions, workmen must be sure their positions are secure. Every precaution must be taken, also, to protect personnel below. Unless absolutely necessary, work is not to be performed directly beneath workers aloft.

4. Safety in Climbing

1. A workman shall never carry tools or materials in his hands while climbing.
2. Pins, braces, or guy wires shall not be used as handholds.
3. When more than one man is to ascend or descend, the first man must reach either his new working position or the ground before the second man starts to ascend or descend.
4. A workman shall never loop a rope over his hand or arm while climbing, since it may cause him to fall. He should loop one end of the rope over his pliers or connectors.

5. Special Precautions for Working on Poles. The following precautions are to be observed in connection with work on poles:

1. Poles that appear unsafe for a man to climb must be properly braced or guyed.
2. Special care must be observed in checking pine poles, as they deteriorate quite rapidly.
3. If a pole is unsound, it must be supported with pikepoles or guy lines before wires are removed or excavation started.
4. Wires and supporting guys must not be removed from a pole until the condition of the pole butt has been determined.
5. While a man is climbing or working on a pole, he is to watch for and report such dangerous conditions as defective guys, braces, or arms, rusted hardware, and other hazards.
6. The insulating value of a wood pole is not to be depended upon.
7. When it is necessary to move a pole from one point to another, nearby workers who might be struck by the pole are to be warned. A man with a red flag is to warn or stop traffic.

6. Special Precautions in Working on Trees. The following precautions are to be observed in connection with working in trees:

a. PREPARING THE TREE

1. Do all possible trimming of the tree from the ground or from a ladder.
2. If at all possible, remove with a pruner all branches which touch wires energized at more than 300 volts.

b. CLIMBING THE TREE

1. Ascertain whether it is safe to climb a tree by inspecting the trunk at a point near the ground.
2. Wear rubber-soled shoes or rubbers, if possible, when climbing trees.
3. Do not wear climbers, except when trees are to be removed; then wear them only under the supervision of the man in charge.
4. Be particularly careful while climbing trees in wet weather, and use extreme care during winter months, as branches are usually brittle when cold.
5. Observe special care when climbing soft-wood trees or trees growing close to buildings. In such cases the roots may be rotted or may have grown in one direction.
6. Keep your feet as close to the main stem

as possible when stepping on branches.

7. Remove dead limbs and stubs while climbing in order to minimize hazards when descending.
8. Do not rely on decayed limbs or small branches for support.

c. CUTTING THE LIMBS

1. Saws shall be used for cutting trees. Never use hand axes, chopping axes, chisels, or draw-knives.
2. Tie the butt end of a large limb in place with a sling or a bull rope before the cut is started.
3. Never sit on, or attach your safety belt to, a limb which is being removed.
4. Never cut a limb directly above you unless absolutely necessary.
5. If it is necessary to work from a position toward the end of a limb, first secure the limb with a bull rope or sling attached to the main stem of the tree trunk. Tie the supporting rope to the trunk at a point well above the limb to be supported, or to a sufficiently strong limb above. As an additional protection, secure a line over a crotch of the main stem of the tree trunk and attach the other end to your safety belt.

18245 WORKING WITH POTHEADS

1. Purpose of Potheads. A pothead is a form of terminator usually used in power and telephone distribution. It may have terminals accessible for testing, or it may have a junction block to facilitate the connecting of cable(s) and wire. It is designed to be hermetically sealed to the cable(s) to exclude moisture.

2. Safety During Work

a. OPENING AND CLOSING CIRCUITS. When opening and closing circuits by means of potheads, open the neutral pothead last and close it first.

b. USE OF INSULATION. Do not stand on a concrete floor or on the ground while working with potheads in manholes or vaults. Use an insulated stool, a crossarm, or other dry lumber. Carefully cover grounded framework. Be particularly careful in locations where water is present.

c. AVOIDING GROUNDED EQUIPMENT. Stay clear of grounded equipment when working on or near potheads.

Section 3

ELECTRONIC SAFETY

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18301 SCOPE OF THIS SECTION

Although the subjects of electricity and electronics are in fact inseparable and precautions for one automatically become precautions for the other, the present-day use of television, radar, and other electronic devices has made electronics commonly thought of as a field in itself.

On board ship, particularly, personnel are aware of electronic devices and the need for special precautions in their use. Therefore personnel shall have a thorough knowledge of the following safety rules in addition to those in sections 1 and 2.

18302 PROTECTIVE EQUIPMENT

1. **Deck Coverings.** Afloat, suitable protective deck coverings shall be used on deck areas around electrical equipment. Rubber matting, Stock Number 27M701, in accordance with Specification MIL-M-15562A, shall be installed on:

1. Areas which may be contacted by personnel engaged in operating and servicing radio, radar, sonar or countermeasures equipment, or associated test equipment where nominal voltages of 115 volts or greater are employed.
2. Operating spaces in the front and rear of power and lighting switchboards.

2. **Use of Permanent Matting Aboard Ship.** Rubber matting (MIL-M-15562A) is to be a permanent installation. Only areas which afford the maximum facility in operating and servicing the equipment are to be covered. The matting is to be secured with cement conforming to Specification MIL-D-2905, Stock Numbers 52-C-346-50 or 52-C-346-75, or cement conforming to BuShips Specification 52-C-15,

Stock Number 52-C-1566-750. Rubber is to be installed without cementing on grating and removable floor plates.

3. **Rubber Matting for Shore Installations.** For shore installations, rubber matting in accordance with the above specifications shall be suitably located and installed on the floor areas around equipment employing nominal 115 volts or higher.

4. **Testing Rubber Protective Equipment.** Devices shall be provided for the periodic testing of rubber protective equipment. Such devices shall be approved by Underwriters Laboratories. Each piece of equipment shall be provided with a rubber calendar which is to be used to maintain a record of the last date on which it was tested. Equipment which passes the test shall be marked with an electric pencil in the appropriate place on the calendar. Equipment which fails to pass the test is to be repaired or replaced.

5. **Warning Signs.** The following Bureau of Ships drawings have been prepared for suitable warning signs:

1. HIGH VOLTAGE (RE 10 AA 608A)
2. STACK GASES (RE 10 AA 529A)
3. EXPLOSIVE VAPORS (RE 10 A 589A)

18303 GENERAL ELECTRONIC SAFETY

1. **Precautions with Radio Frequency Circuits.** Detailed safety in the operation of electrical circuits is prescribed in section 2, subsection B. Because of the constant use of radio aboard ship, however, the following precautions for radio frequency circuits are emphasized here:

a. **BREAKING HIGH-VOLTAGE CIRCUITS.** Energized high voltage output circuits should not be broken except when absolutely necessary and authorized by a qualified officer.

b. PREVENTING SHOCK FROM ADJACENT EQUIPMENT. When other transmitting equipment is in use at the same installation or close by, workers should be on the alert to prevent shock, burns, or other injury to personnel due to energy picked up from adjacent antennas or equipment. Circuits should be grounded where necessary to protect personnel against such shock or burns.

2. Avoiding Danger From Detonators or Igniters. Electric detonators or igniters, electrically fired rocket motors, or electric fuzes (ordnance) shall not be located in the same compartment with or be exposed within five feet of any exposed electronic transmitting apparatus or exposed antenna or antenna lead aboard ship or at a shore electronics activity. No danger due to radio frequency potentials exists with detonators of any type while they are in a covered metal container.

3. Working With the Capacitor. Before a worker touches a capacitor which is connected to a deenergized circuit, or which is disconnected entirely, he is to short-circuit the terminals to make sure that the capacitor is completely discharged. A suitably insulated lead or a shorting or grounding bar should be used for this purpose.

4. Adjustment of Electronic Equipment. Adjustments shall not be made on electronic equipment while motor generators are running or rectifiers are energized, unless the adjustments can be accomplished by the use of the exterior controls normally provided for this purpose.

5. Energizing When Ship Is in Drydock. The electronic equipment of a ship may be energized only with the express permission of the Docking Officer. The hull must be adequately grounded. Excitation is not to be applied to a sonar transducer unless the transducer is properly immersed. A transducer is not to be lowered by gravity or power feeds.

18304 PRECAUTIONS AGAINST ACCIDENTAL ENERGIZING

The use of electronic equipment in the frequency range of 30 megacycles and below will cause voltages to be induced in the standing rigging and other portions of a ship's struc-

ture that, under certain conditions, must be considered hazardous. Operation in the higher frequencies (above 30 mc) is not considered hazardous in this respect because of the remote location of antennas from the normal working areas in a ship. The voltages, or resonant circuits, set up in a ship's structure or rigging will cause shock to personnel or produce open sparks when contact is made or broken, when the circuit is opened or when metallic objects are in contact with the structure.

During the handling of ammunition, volatile liquids, or gases (particularly fueling operations involving delivery of gasoline from hoses, spouts, cans, or any place where gasoline vapors are present), adequate precautionary measures must be taken to nullify the hazards mentioned above. See chapter 5, section 1 of this manual.

1. Handling Electronically Detonated Ammunition. The danger of firing primers, detonators, rockets, ammunition, VT fuzes, destructors, and other electrically controlled circuits is not great under normal operating conditions, since construction of these units effectively shields their firing circuits. During the handling of ammunition, volatile liquids, or gases where booms, cranes, or burtoning wires are used, the following precautions must be observed:

1. Call attention of the deck force or others to hazards involved.
2. Use an insulated steering hook for guiding boom or crane cables.
3. Insulate the loading hook from burtoning wire, crane, or boom cables by use of manila rope or strain insulators.
4. Observe all safety precautions with respect to ventilation, dangers from sparking, insulation of rigging, etc., as listed in chapter 5 of this publication.

2. Avoiding Hazards From Nearby Ships. The hazards referenced above are mainly due to the operation of the ship's own electronic transmitting equipment. Caution must be exercised also when the antennas of nearby ships or shore stations are energized.

3. Other Hazardous Areas. Although the many variables encountered on service in-

installations preclude approximation of the possible voltages encountered, the following examples are cited:

1. Excessive radio frequency pickup from ship antennas has been noted on smoke-stack guys, davit head spans, and the like.
2. A similar high frequency radio pickup has been observed on board ship, particularly carriers, when the length involved in reeling in or paying out wire cable and wire hawsers becomes resonant to the emitted frequency.
3. An aircraft company's fire department recently conducted a series of tests to determine the possibility of igniting flammable liquids with radar beams, using medium powered beams and standard aviation gasoline. Where metals in the radar beam were close to fuels, ignition of the fuel occurred at distances of less than 25 feet. These tests indicate that high radio frequency voltages are induced in steel tools near the center of the beam, and the resulting discharge may cause an arc of sufficient intensity to ignite gasoline fumes. It is also possible that light metals in the beam might become heated enough to ignite flammable vapors.

18305 PRECAUTIONS FOR HANDLING CATHODE RAY TUBES

The trend toward the use of larger cathode ray tubes has increased the danger of implosion, flying glass, and potential injury and severe shock from high voltage. Tubes are not dangerous if properly handled. If they are handled carelessly, struck, scratched, or dropped, they can very well become an instrument of severe injury or death. The following precautions shall be taken for the protection of personnel:

1. Personal Protection

a. **USE OF GOGGLES.** Wear goggles to protect the eyes. Envelope fracture combined with vacuum within the tube can result in implosion and flying glass particles. Goggles which provide side and front protection and have

clear lenses which will withstand a fairly rigid impact test are prescribed.

b. **USE OF GLOVES.** Wear suitable gloves to protect the hands.

c. **BODY PROTECTION.** Be sure that no part of the body is directly exposed to possible glass splinters caused by implosion of the tube. The coating on some tubes is poisonous if absorbed into the blood stream.

2. **Care of Tubes.** Do not expose tubes unnecessarily to possible damage. When a tube is needed remove it from the packing box with caution, taking care not to strike or scratch the envelope. Insert it into the equipment socket cautiously, using only moderate pressure. Do not jiggle the tube. These precautions also apply when removing tubes from equipment sockets. When the tube must be set down it is important that the face be placed on a clean, soft padding. Do not stand directly in front of the tube face, for accidental implosion may cause it to be propelled directly forward with a velocity sufficient to cause severe injury.

18306 WORKING ON ANTENNAS

1. **Caution to Personnel.** Division officers shall caution all men in their divisions not to go closer than 1 foot to an exposed radio antenna unless it is first determined from competent authority that the antenna is not energized. Men must not tamper with or attempt an inspection of any unit of radio communication and entertainment equipment. This equipment carries voltages dangerous to life.

2. **Antennas Operating on High Frequencies.** The radio officer or the electronics officer shall notify the commanding officer before using antennas radiating on frequencies between 10,000 and 60,000 Kcs. The commanding officer shall not permit the antennas to be energized whenever they are less than 50 feet from the following hazards:

a. **GUNS.** All guns not in mount or turret fitted with electric firing circuits, either during the process of loading or in the loaded condition (live ammunition).

b. **AMMUNITION.** All ammunition fitted with electrical primers, when not in mount, turret, or ammunition container.

c. **FLARES.** Aircraft employing unshielded flare circuits whenever flares are installed.

d. **GASOLINE VAPOR.** Gasoline fueling operations involving the delivery from hoses, spouts, cans, etc., or any place where gasoline vapors are present.

e. **POWDER.** Powder-handling operations involving open tanks or exposed powder.

f. **OIL FUELING.** Oil-fueling operations during the interval of time required to make or break metallic connections.

g. **DETONATORS.** Exposed electrically fixed detonators.

3. Working Aloft. Before any work may be done aloft authorization must be obtained from the commanding officer. While antennas are energized by radio transmitters, men shall not be permitted to go aloft except by means of ladders and platforms rendered safe by grounded hand rails or similar structures. Before sending men aloft, except as noted above, the commanding officer shall direct the communication watch officer to secure the proper transmitter in order to render safe this area, and shall notify the engineer duty officer that men will be working in a prescribed area aloft in order that the engineer duty officer may take the necessary precautions to prevent the boiler safety valves from lifting. Until he has received a report from the communication watch officer that the proper transmitters are secured, the commanding officer shall permit no man to go aloft. After the work has been completed a report shall be made to the commanding officer, and his authorization must be obtained before the circuit is again energized.

4. Danger from Rotating Antennas. Radar and other antennas which rotate or swing through horizontal or vertical arcs may cause men working aloft to fall. Therefore, the motor switches which control the motion of these antennas should be locked open and tagged before men are permitted to ascend or go within reach of them.

5. Antenna Poles. To secure antenna pole guys, see 09105 for rigging precautions and 09122 for wire rope safety.

6. Radio Transmitters in Aircraft. Radio transmitters installed in aircraft shall not be operated during fueling of aircraft, or within 50 feet of any such fueling operation. Before operating radio transmitters in aircraft, inspection shall be made of the antennas to insure that they are not touching fabric-covered portions of another aircraft parked nearby. Radio transmitters shall not be operated within the confined hull of an aircraft after the aircraft has been fueled until the hull has been thoroughly ventilated and cleared of fumes, or at any time when gasoline vapors appear present. Storage batteries shall not be disconnected or removed from their circuits within any aircraft immediately after flight without first ventilating the container to allow any gas accumulated during charging to escape. An inspection shall be made before removal to insure the opening of all switches, to prevent the possibility of a spark being generated at the terminal of the battery when the connection is broken.

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United States Navy
SAFETY PRECAUTIONS

Chapter 19
RADIOLOGICAL SAFETY

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

Section 1

STANDARDS AND ADMINISTRATION

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Subsection A

INTRODUCTION

19101 SCOPE OF THESE REGULATIONS

The radiological safety regulations included in this chapter are intended for peacetime use by the Navy in laboratory and industrial operations. They are not and shall not be construed as applicable to atomic defense procedures.

19102 SUPPLEMENTARY SOURCES

Because of the technical nature of this chapter and the many details involved, additional material for study is listed here. The National Research Council's "Glossary of Terms Used in Nuclear Science and Technology," gives definitions of terms. The glossary may be obtained from the American Society of Mechanical Engineers, 29 West Thirty-ninth Street, New York, N. Y., who publish it and sell it at cost. In addition, the following books and pamphlets are recommended as supplementary material for study:

1. Miscellaneous Publications

1. Regulations of the Interstate Commerce

Commission for the transportation of explosives and other dangerous articles are obtainable from the Superintendent of Documents, Washington, D. C., under the title *1950 Revision of the 1949 Edition, Code of Federal Regulations, Title 49, "Transportation,"* parts 71-90. Annual cumulative supplements are also available.

2. Photodosimetry Manual (NavMed P5005). Bureau of Medicine and Surgery, United States Navy Department, Washington, D. C., 1952.
3. Radiological Safety Regulations (NavMed P-1325), Bureau of Medicine and Surgery, United States Navy Department, Washington, D. C., 1951 (includes a 1952 revision of ch. 5).
4. Radium Hazard in a Military Aircraft Instrument Shop by Skow, Sobol, and Wadleigh. United States Naval Radiological Defense Laboratory, San Francisco 24, 1951.

2. National Bureau of Standards Handbooks

1. #H23, Radium Protection, 1938.
2. #H27, Safe Handling of Radioactive Luminous Compound, 1941.
3. #41, Medical X-Ray Protection Up to Two Million Volts, 1949.
4. #42, Safe Handling of Radioactive Isotopes, 1949.
5. #49, Recommendations for Waste Disposal of Phosphorus-32 and Iodine-131 for Medical Users, 1951.
6. #50, X-Ray Protection Design, 1952.
7. #51, Radiological Monitoring Methods and Instruments, 1952.
8. #52, Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentrations in Air and Water, 1953.

19103 DEFINITIONS

1. Radioactive Area. In the absence of any detectable contamination with alpha-emitting material, any area where the total beta-gamma radiation intensity consistently does not exceed 0.015 roentgens per 24 hours may be considered nonradioactive.

2. Radioactive Material. Radioactive material is any material that spontaneously emits ionizing radiation.

19104 SERIOUSNESS OF RADIOLOGICAL HAZARDS

The serious nature of radiological hazards calls for the most scrupulous observance of precautions. Radium, for instance, is continuously active, sending off radiations at all times, and precautions must constantly be observed to protect personnel and equipment.

In order that personnel working in a radioactive area may be properly informed as to the hazards and the safety measures to be observed, initial and continued indoctrination must be provided. It is particularly important that persons in immediate charge of working parties be aware of their specific responsibilities with regard to the supervision and execution of safety measures.

Various aspects of radiological safety, particularly maximum permissible exposure levels (MPE), are constantly being studied and revised, and changes will be necessary for some time to come. As quickly as possible such changes will be issued in connection with this publication. The rules of this chapter supersede all radiological safety rules published prior to this date. Because any amount of radiation has some effect on the body, personnel shall keep well below the specified MPE levels whenever possible.

Subsection B**SELECTION AND EXAMINATION OF PERSONNEL****19121 PREEMPLOYMENT EXAMINATIONS**

1. Personnel Involved. Personnel being considered for assignment to duty requiring regular exposure to ionizing radiation or the handling of radioactive materials, shall be given a medical examination.

2. Exemptions. Personnel physically qualified for duty, who have not been previously exposed regularly to ionizing radiation, or who have not worked with radioactive isotopes, may be exempted from this examination. Such personnel may be detailed to any area where the total beta-gamma radiation intensity consistently does not exceed 0.015 roentgen per 24 hours, without special medical examinations

or personnel dosimetry, provided this assignment does not exceed a period of one year. Routine radiation monitoring, however, will be performed as prescribed in these regulations.

3. Nature of Examination.

a. SCOPE. The preemployment examination will be a complete physical examination, including blood examination, urinalysis, breath samples, and chest X-ray. If a similar examination has been conducted within the past six months, it will be accepted, provided a record of such examination is available as part of the individual's record.

b. BLOOD EXAMINATION. A complete blood count, including a leukocyte differential count, will be made on three successive days prior to

lunch for the purpose of establishing a normal baseline for later use in the evaluation and detection of early radiation injury.

c. **URINALYSIS.** A radiochemical urinalysis will be made on personnel who have previously engaged in handling of plutonium, uranium, or radioactive rare earths.

d. **BREATH SAMPLES.** Breath samples for the determination of radon concentration shall be taken for personnel who will be engaged in the handling of radium salts or compounds which are not hermetically sealed.

19122 PHYSICAL REQUIREMENTS

1. **General.** The general physical requirements are those for active duty in the military service or for Civil Service employment.

2. **Disqualifying Findings.** In addition to failure to meet the general physical requirements, the following findings are considered disqualifying:

a. **EXPOSED WOUNDS.** Exposed wounds (whether lacerations, abrasions, or ulcerations) are considered disqualifying for personnel handling radioactive materials which are not hermetically sealed. Personnel with exposed wounds or open lesions are never to be permitted to work in a contaminated area.

b. **BLOOD ABNORMALITIES**

1. Total white blood cell counts below 4,000 or above 12,000 are disqualifying.
2. In cases where abnormal white cell counts may be due to transient diseases or other temporary conditions, reexaminations shall be made upon recovery.
3. Also disqualifying are total red blood cell counts below 3.5 million or above 6.5 million and persistently abnormal leukocyte differential counts.

c. **URINE.** The presence of plutonium, uranium, or radioactive rare earths in the urine disqualifies a person for employment.

d. **BREATH.** The presence of more than 5×10^{-13} curie per liter of radon in expired air is disqualifying.

e. **OTHER.** Any evidence of previous radiation injury which is considered disqualifying by the medical examiner shall bar a person from employment.

19123 FOLLOW-UP EXAMINATION

1. **When Conducted.** Personnel engaged in work involving regular exposure to ionizing radiation or handling of radioactive materials shall be reexamined at the discretion of the radiological medical officer.

2. **Nature of the Follow-Up Examination**

a. **SIGNS OF CHRONIC RADIATION.** Examiners will be alert for signs of chronic radiation damage, such as lack of vitality, loss of appetite, weight loss, cracking of the skin on fingers, and excessive longitudinal corrugation and brittleness of the fingernails. These findings shall be recorded on the physical examination form.

b. **TESTS FOR CHRONIC RADIATION**

(1) **Blood Counts.** Complete blood counts, including leukocyte differential counts, shall be made when indicated, at intervals not greater than 4 months. The specimens shall be collected immediately prior to lunch.

(2) **Urinalyses.** Where appropriate, radiochemical urinalyses shall be made at intervals of 4 months.

(3) **Breath Samples.** Breath samples shall be collected at intervals of 6 months from personnel engaged in the handling of radium salts or radium compounds which are not hermetically sealed. These samples shall be submitted to the National Bureau of Standards for radioanalysis in accordance with the Bureau of Medicine Instruction, 6470.2.

(4) **Exceptions.** Chest X-rays and routine urinalyses are not considered an essential part of the reexamination of individuals engaged in working with radioactive materials or radiation unless specifically indicated.

19124 SPECIAL OR EMERGENCY EXAMINATIONS

1. **Over-Exposure to External Radiation.** An individual receiving external radiation greater than 25 roentgens in a single exposure requires immediate hospital evaluation.

2. **Possible Over-Exposure to Internal Radiation.** In the event personnel may possibly be exposed to ingestion or inhalation of significant amounts of radioactive material, special radiochemical examinations shall be performed as indicated.

3. Abnormal Findings. Individuals showing abnormal findings in any special or routine follow-up examinations shall be removed from further exposure to radiation and given an exhaustive examination.

19125 EXAMINATION RECORDS

1. Physical and Laboratory Examination Reports

1. The results of physical and laboratory examinations given preliminary to the individual's commencing radiation work, and subsequent to his final separation from all such duties, shall be recorded on Standard Forms 88 and 89 and shall be transmitted through regular channels to the activity normally receiving those forms.
2. Interim and special examinations shall be recorded on the SF-600 of the Health Record or in the Industrial Health Jacket, as appropriate. Total previous exposure to radiation and type of work performed

shall be recorded on Standard Form 88 under "Remarks."

2. Monthly Accumulative Reports of Radiation Exposure. Monthly accumulative reports of radiation exposure shall be noted on the current SF-600. The exposure dosage during the current month, the number of days exposed during the current month, and the cumulative total exposure to date are to be indicated.

3. Reports on Total Cumulative Exposure. Total cumulative exposure in roentgens and total days, shall be noted on the SF-600 under the following conditions:

under the following conditions:

1. Detachment or transfer.
2. Termination of Health Record.
3. Opening of a new Health Record.

Upon the forwarding of medical history sheets to the Bureau of Medicine and Surgery, an abstract of the total cumulative radiation exposure, and total time involved in days, shall be made a part of the medical abstract and entered upon the new SF-600 indicated.

Subsection C

MAXIMUM PERMISSIBLE EXPOSURE LEVELS

Reference has been made in article 19103 to MPE levels and to the probability that these levels will be changed in accordance with new theories. At present the following regulations of this subsection apply.

19141 LIMITING EXPOSURE

1. Limiting Individual Exposure. MPE levels do not represent limits within which there can be complete disregard of exposure. Exposure to ionizing radiation should be kept to an absolute minimum in all circumstances. Needless exposure to radiation should be avoided.

2. Limiting Access to Radioactive Areas

1. Insofar as possible, access to radioactive areas shall be limited to working personnel.
2. Sightseeing and other nonessential activities shall be discouraged.
3. Measures shall be taken to prevent souvenir hunting or looting.

4. Areas which have been found radioactive and areas in which radioactive vessels are moored shall be restricted to official business.

5. Sentries and guards shall be posted where necessary to prevent access to these areas by unauthorized persons.

3. Adjusting Annual Leave. It is suggested that personnel coming under the jurisdiction of these safety precautions divide their annual leave into at least two, but no more than three, equal parts taken at 6- or 4-month intervals, except for emergencies. Such an arrangement will take advantage of certain regenerative processes that may come into play between two exposures to low-intensity irradiation and will help to limit cumulative exposure.

4. Handling of Objects. The handling of objects must be kept to a minimum. Cotton gloves give some protection against contamination and should be worn when contamination is

likely, unless another type of glove is required. It should be remembered that distance is always the best protection against exposure.

19142 INDEXES

The following indexes for exposure under various conditions will serve as a guide for MPE levels. Personnel shall keep well under these levels whenever possible.

1. External Radiation

a. TOTAL EXPOSURE

(1) *Basic Index.* The MPE for total body exposure is 0.3 r (or 0.3 rep) acquired in a single or several doses over a period of one week. It is recommended that exposure levels of 0.05 r (or 0.05 rep) or less per 24-hour period be maintained for routine operations. Integrated exposures greater than 0.3 r per week require removal of the individual from further exposure until "recovery" can be effected, using 1 week as the time index of exposure.

(2) *Monthly Index.* In the case of individuals who will be working with external radiation for a period not exceeding two years, the MPE is established as 1.25 r per month. This may be obtained in a single exposure provided there is no additional exposure to radiation for one month.

b. *LOCAL EXPOSURE.* A local external MPE of 1.0 r per week is established for beta radiation exposure to the hands.

c. *EMERGENCY EXPOSURE.* In case of fires or accidental spills where workers such as firemen, who are not being regularly exposed to ionizing radiation, may be exposed in an emergency, an MPE of 5 r is allowable at one time, provided proper protective and indicative devices, such as masks or respirators and self-reading dosimeters, are worn, and provided a total of 15 r is not exceeded in one year.

d. *EXPOSURE TO HIGH ENERGY PARTICLES.* Exposure to high energy particles from piles or accelerators, such as cyclotrons and betatrons, require special MPE considerations not within the scope of these regulations, although in general an MPE of 0.3 r (rep) should be followed.

2. Internal Radiation

a. *MAXIMUM ALLOWABLE BODY DEPOSITION.* Lifetime allowances for the body deposition of certain alpha-emitting materials are as follows:

1. Radium—0.1 microgram.
2. Plutonium—0.5 microgram (0.04 microcurie).
3. Others—As lifetime allowances for body deposition of other elements are determined they will be added to these regulations.

b. *MAXIMUM ALLOWABLE AIR CONCENTRATIONS.* The following concentrations shall not at any time be exceeded in areas occupied by personnel:

1. radon— 10^{-11} curie per liter of air, including radon from both airborne and surface radium contamination.
2. plutonium, radium, and other alpha-emitting heavy isotopes— 5×10^{-12} microcurie per cc. of air for continuous exposure for 1 year.
3. Beta and Gamma Emitters—approximately 10^{-9} microcurie per cc. of air for the more hazardous beta-gamma emitting isotopes, such as iodine, strontium, and barium. When the air concentration reaches this level, masks shall be worn. Should the concentration increase by a factor of 10 (i. e., a concentration of 10^{-8} microcurie per cc.), the area shall be evacuated.

3. *Maximum Permissible Level of Radioactivity in Food or Water.* No food or water known or suspected to be radioactively contaminated shall be consumed until it has been carefully tested. The level of food contamination by radioactive materials (beta-gamma or alpha-emitting) which is considered to be significant is 10^{-7} microcurie per cc. or gram. Eating, drinking, smoking, and gum-chewing are prohibited within a radioactive area. These activities should be permitted only after personnel have left the radioactive area and have been thoroughly decontaminated.

19143 DETERMINATION OF EXPOSURE

1. Photodosimetry

a. *DEFINITION.* Photodosimetry is the determination of exposure of an individual to pene-

trating, ionizing radiation by the use of photographic emulsions of requisite sensitivity to beta, gamma, and X-radiation.

b. **PHOTODOSIMETRY UNITS.** A photodosimetry unit consists of a densitometer (a photographic analyzer for the accurate measurement of the darkening of films as the result of exposure to radiation), X-ray developing facilities, special films, and film badge holders. At least one X-ray technician qualified in photodosimetry will work with the unit.

c. **PROGRAM ESTABLISHMENT.** Photodosimetry units shall be established by naval medical facilities. These dosimetry units shall be sufficient to provide film badge service for all naval and civilian personnel under naval cognizance who are regularly exposed to ionizing radiation, whether from the handling of radioactive materials, from X-rays, or from any other exposure to ionizing radiation. This shall be a responsibility of the senior staff medical officer ashore or afloat. Fleet Marine Force medical and dental facilities shall be considered as an activity afloat for this purpose.

d. **WEARING OF FILM BADGES.** Film badges shall be worn by all naval personnel (service and civilian) who are engaged in the handling of radioactive materials or are working with radiation and by all persons who enter a radioactive area.

e. **PROCESSING.** Film badges shall be processed and read at the discretion of a qualified radiologist or radiological medical officer, with a maximum interval of one month between readings.

2. Evidence of Overexposure

1. An individual whose exposure has exceeded 0.3 r (rep) per week shall be excluded from further exposure to penetrating radiation until sufficient time has elapsed to bring his total exposure within the MPE.
2. Each day free from exposure will be considered to compensate for 0.05 r (rep) overexposure. For example, an individual who has received an exposure of 0.45 r in a period of 1 week has an overexposure of 0.15 r. The overexposure divided by the daily recovery factor of

0.05 r gives the number of days he should be removed from further exposure: $0.15/0.05$ equals 3 days. However, to determine the MPE for the week following the overexposure, the actual overexposure must be deducted from the standard MPE of 0.3 r per week, i. e., 0.3 r minus 0.15 r (0.15 rep) would leave a remainder of 0.15 r (0.15 rep) allowable exposure for the week in question.

3. Where exposure of the individual to X- or gamma radiation is likely to exceed the MPE, the film badges should be augmented by the use of pocket dosimeters.

19144 REPORTS

1. Annual Reports

a. ACTIVITIES HAVING A PHOTODOSIMETRY PROGRAM

(1) *Origin of Report.* An annual photodosimetry report shall be submitted at the end of each calendar year by activities having a photodosimetry program and by any activity that utilizes the photodosimetry film badge. The report shall originate from the cognizant Medical Department representative or the Radiological Health Officer and shall be submitted via official channels to the Bureau of Medicine and Surgery, Code 74, not later than 15 January.

(2) *Personnel Included in Report.* The annual report shall include records for all exposed individuals on board at the end of the calendar year plus all individuals exposed elsewhere during the calendar year but transferred prior to the end of the calendar year.

(3) *Data to Be Included.* The annual photodosimetry report shall consist of a list of all exposed personnel (service and civilian). The following information shall be given in the reports:

1. Full name.
2. Rank or rate.
3. Serial or service number.
4. Number of weeks employed in radiation work during the current year.
5. Total cumulative open-window exposure in rep for beta or roentgen for X-ray.

6. Total cumulative shielded exposure (hard gamma or X-ray) in roentgens during the calendar year.

b. **ACTIVITIES NOT HAVING A PHOTODOSIMETRY PROGRAM.** Activities not having a photodosimetry program or not utilizing the photodosimetry film badge shall submit this annual report only in the case of personnel "on board" who were exposed elsewhere during the calendar year. This will require a study of the health records of personnel attached and the submission of the data required by paragraph 5-9(2) NavMed P-1325 as recorded on the current Medical History Sheets SF-600. Negative reports are not required.

2. Special Reports. In the event that an individual receives a greater exposure than 0.3 r

within a period of any 1 week of the calendar year, which shall be determined at the time of processing and reading of the film badges, the circumstances shall be explained immediately in a special photodosimetry report. Film badges that are processed and read on a 2-week basis should not exceed 0.6 r; those processed and read on a 4-week basis should not exceed 1.20 r for that period, etc. In any case of greater readings it must be assumed that overexposure has taken place within the exposure period, and the submission of the special photodosimetry report is required. This special report shall be forwarded via official channels to the Bureau of Medicine and Surgery, Code 74.

Section 2

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Subsection A

GENERAL WORKING PRECAUTIONS

19201 VARIATIONS IN HOUSEKEEPING RULES

Housekeeping procedures vary from isotope to isotope and vary with the amounts used. For example, activities utilizing microcurie or tracer amounts would have considerably more lenient housekeeping procedures than those utilizing millicurie or curie amounts. Also, in particular, since alpha-emitting isotopes are such an internal hazard, long-lived alpha emitters such as radium and plutonium require special precautions.

Because of this great variation it is possible to set forth in a manual of this kind only general procedures. Personnel shall acquaint themselves with these and with the specific precautions set forth by the Radiological Safety Officer in the area involved.

The following general rules shall apply to all areas where radioactive materials are used:

1. There shall be a continuous and rigid adherence to all safety rules by all workers.
2. Working conditions themselves must be safe and must encourage cooperation.
3. Neat and orderly housekeeping must be carried on at all times.
4. No extraneous objects shall be permitted on the work table.
5. All equipment shall be kept in a neat and clean condition at all times.
6. All equipment shall be left clean at the end of each working period.

7. Personally owned tools and other equipment shall not be used in radioactive areas.

8. All necessary tools shall be Navy issue and shall be provided upon leaving the "change station."

19202 FIRE PREVENTION AND PROCEDURES

1. **Prevention of Fire.** Fire prevention methods in general are the same in a radioactive area as in any other area, and personnel shall follow all usual precautions. In addition, care shall be taken to store no flammable materials near radioactive materials.

2. **Procedures During Fire.** Fire in a radioactive area constitutes a particularly great hazard because of the danger of widespread contamination in addition to the usual dangers of fire. The following procedures shall apply:

1. The Fire Department shall be immediately notified and shall be told that a radiation hazard exists.
2. All persons in the room and in the building, including the Radiological Safety Officer, shall be immediately notified.
3. Evacuate surrounding areas. Sightseeing crowds are a danger during any fire, and in a radioactive area they multiply the possibility that contamination will be spread.
4. Govern fire fighting and other emergency activities by the restrictions of the Radiological Safety Officer.

5. During and following the emergency, monitor the area and determine the protective devices necessary for safe decontamination.
6. Decontaminate the area.
7. Permit no person to resume work without approval of the radiological safety officer.
8. Monitor all persons involved.
9. Prepare a complete history of the emergency for the laboratory records.

19203 DUST HAZARD

Attention must be paid to avoiding dust clouds. If possible, all surfaces in a workroom where radioactive materials are being used should be covered with a special paper with a moderately adhesive wax surface. At the end of the day the paper is disposed of according to regulations. Other precautions are as follows:

1. Rust, paint scale, and other such debris must not be tracked about, thereby creat-

ing dust hazards. Such material is apt to be highly contaminated.

2. Before a dust-producing operation is begun, it must be determined that no injury to persons nor contamination of property can result.
3. A radioactive area shall not be dryswept. This does not apply to small localized operations for collecting dust samples for analysis. If it is necessary to clean a space, this can be done by mopping or flushing down.
4. The use of the rotary wire brush is specifically forbidden.
5. Mops must not be wrung out by hand and should be hung up to dry after they have been used.

19204 WATER HAZARD

Personnel must avoid stepping in pools of water, since it is possible for "shifting contamination" to occur as fission products are washed by rain from one place to another.

Subsection B

PERSONNEL PROTECTION

19211 EQUIPMENT

1. Protective Clothing

a. TYPES. Each naval activity handling radioactive materials shall provide protective clothing for the personnel engaged in such work. The type required will vary with the local situation and may include the following:

1. A baseball or surgical cap or other tight-fitting head covering.
2. Safety glasses.
3. A suit of coveralls fastened to the neck, with sleeves rolled down and openings of pockets sewed up.
4. Underwear.
5. Stout shoes or rubber boots covered by disposable "bootees."
6. Socks.
7. Canvas gloves for manual labor and surgical or other rubber gloves for laboratory work.

b. CARE OF CLOTHING

1. Workers shall be provided with a dressing room, or "change station," where they shall change from street to working clothes. (See article 19302, paragraph 1.)
2. Working clothes shall not be worn during meal or rest periods or carried away from the plant by workers. They shall be left in the dressing room at the end of each day.
3. No working equipment of any kind shall be placed or stored in the dressing room.
4. Clothing which is contaminated so that it emits a radiation level of more than 0.05 r (rep) per working day, gamma plus beta, or is contaminated with an alpha-emitting material, shall not be worn. It must be decontaminated or disposed of. *Contaminated clothing shall never be disposed of by burning.* (See sec. 3,

art. 19302 for decontamination procedures.)

2. Inhalation Equipment

a. **TYPES.** The following types of masks and respirators are authorized for use in radioactive areas:

1. Army Assault Mask with M-11, E-12, or M-10-A1 canister.
2. Navy Combat Mask, MK-IV, with B-2 canister.
3. Rescue-breathing apparatus.
4. Positive-pressure breathing mask with uncontaminated air or oxygen supply.
5. Mask with self-contained air or oxygen supply.

b. SPECIFIC USES

1. The Army Assault Mask with the M-11, E-12, or M-10-A1 canister, or the Navy Combat Mask, MK-IV, with B-2 canister, is to be used by personnel working in a radioactive area where an adequate supply of oxygen is present and where there are no toxic fumes.
2. The rescue-breathing apparatus, the positive-pressure breathing mask with uncontaminated air or oxygen supply, or the mask with self-contained air or oxygen supply are to be used by personnel working in an area in which radioactivity is present in the air, in which a deficiency of oxygen exists or is suspected to exist, or where noxious gases are present.
3. Respirators will be needed frequently by firemen where there is an inhalation hazard, and for other emergency uses.
4. Respirators need not be worn by personnel performing such duties as monitoring or inspection under dust-free conditions.

c. **INSTRUCTIONS AS TO USE.** If inhalation equipment is used, it is essential that personnel be carefully instructed in its use and be familiar with the safety precautions involved.

d. **CANISTERS.** After the Army Assault Mask or the Navy Combat Mask with the appropriate canister has been used, all canisters will

be monitored. If they are found to be contaminated, the filter papers shall be removed and the canisters shall be decontaminated by available means, including placing them on a shelf for the appropriate decay period. At the end of this period the canisters shall again be monitored. If safe MPE levels (less than 0.015 r/24 hours, gamma plus beta, no alpha contamination) have been reached, the canisters with new filters may again be used.

19212 PERSONAL CARE

1. Cleanliness

1. No edibles of any kind, including chewing gum, candy, or beverages, shall be brought into the workroom, nor shall they be touched before all traces of radioactive materials are removed from the hands.
2. Convenient facilities for washing, including solvent and hot water, shall be provided. Supervisors shall insist that operators scrub their hands thoroughly at the end of each working period.
3. Workers shall be provided with individual towels and soap.

2. **Care of Injuries.** In case of injury to personnel working with radioactive materials, the following procedures shall be followed:

1. Wash minor wounds immediately, under running water, while spreading the edges of the gash.
2. Report all radiation accidents to the Radiological Safety Officer.
3. Immediately call a physician qualified to treat radiation injuries. (A list of suitable physicians should be posted near all work areas.)
4. Permit no person involved in a radiation injury to return to work without the approval of the Radiological Safety Officer.
5. Prepare a complete history of the accident and treatment for the laboratory records.

Subsection C

SPECIAL PRECAUTIONS FOR SPECIFIED AREAS

19221 CONTAMINATED SHIPS

1. **General.** Radiological safety regulations in other sections of this chapter shall be applied during operations on contaminated vessels.

2. **Mooring**

1. Contaminated vessels should be moored, if possible, in locations where the wind will not carry contaminated dust, spray, or other materials toward inhabited areas.

2. If a contaminated vessel is to be dry-docked, utmost care must be taken that persons are not exposed to excessive radiation and that the drydock is not unnecessarily contaminated.

3. **Ventilation**

1. A ship's ventilating system is not to be operated except as approved by the commanding officer upon the advice of the Radiological Safety Officer and Radiological Medical Officer.

2. Extreme care must be taken when handling compressed air lines to avoid spreading contaminated dust by the air stream from a leaking or parted line. Portable blowers will not be used without such clearance.

3. Dust samples should be taken in a number of areas throughout the ship prior to extensive operations. Careful interpretation of this hazard will be made by the Radiological Medical Officer on the basis of all information available.

4. **Diving Operations.** Diving operations in contaminated water or near radioactive ships may be conducted as necessary, and the following precautions shall be taken:

1. Prior to each descent, divers shall be processed through the change station.
2. They shall wear one film badge and two pocket dosimeters.
3. There must be no open wounds on their bodies.
4. The air supply of the diving gear must

be located so as to avoid the intake of contaminated air.

5. Upon surfacing, divers shall be monitored and processed through the change station. Their diving dress shall be monitored, and if monitoring reveals a contamination of over 0.05 r (rep) per 24 hours, gamma plus beta, or any alpha contamination, it shall be decontaminated.

19222 RADIUM DIAL PAINT SHOPS

1. **Selection and Instruction of Personnel**

a. **AUTHORIZED EMPLOYMENT.** The number of personnel employed in the application of radioactive luminous compound shall be not in excess of the number authorized by the Navy Department for the establishment concerned.

b. **NEATNESS.** Only workers who are naturally neat and careful shall be employed. Continued carelessness or untidiness in handling material during the preliminary training period shall be reason for nonemployment in these operations.

c. **VISION.** Only persons with 20/20 visual acuity, either with or without glasses, and the ability to read Jager No. 2 print, with or without glasses, shall be employed in any room in which radioactive luminous compound is used or handled.

d. **AGE.** No person under 18 years of age shall be employed in any room in which radioactive luminous compound is used or handled.

e. **PHYSICAL EXAMINATIONS.** Physical examinations for personnel shall be in accordance with the rules set forth in section 1, subsection B.

f. **PRELIMINARY TRAINING.** Before any person is allowed to use or handle radioactive luminous compound he shall be given preliminary training, including practice in handling and use of substances, the use of tools, use and care of protective clothing and equipment, and application of the rules for personal hygiene.

1. Preliminary practice shall be with substances that do not contain radioactive ingredients.
 2. The person being trained shall be informed in detail of all known dangers involved.
 3. The person shall be instructed regarding rules and regulations set up for the protection of personnel and shall be directed to observe them in all details.
- 2. Personnel Meters.** The following meters shall be worn by personnel, unless otherwise directed by supervisors, during all working hours:
- a. **POCKET ION CHAMBER**
 1. Each worker should wear a pocket ionization chamber.
 2. The chamber shall be effective up to 200 mr.
 3. Daily measurements shall be recorded.
 4. It is preferable to wear two identical pocket chambers, in which case the lower of the two readings is considered valid. This eliminates casual error due to accidental discharge of one chamber.
 - b. **FILM BADGES.** See section 1, article 19143.
 - c. **WRIST BADGES.** Wrist badges may be worn when working with radioactive material to estimate the hand exposure.
- 3. Workrooms.** Workrooms for the application and handling of radioactive luminous compounds must be physically separated from other working areas, and no other work than that strictly concerned with radioactive luminous compounds shall be done in these rooms. The minimum space per worker in each workroom shall be 12 square feet and 250 cubic feet of air space.
- 4. Ventilation**
1. Forced ventilation shall be provided for all workrooms so that the radon content of the air does not exceed 10^{-11} curie per liter at any place at any time.
 2. The weighing, compounding, and bottling of luminous compound shall be done under appropriately designed hoods with suction ventilation to the outside air. Air movement shall be not less than 100 linear feet per minute at the face of the opening of the hood.
 3. Operators exposed to dust from radioactive luminous compound because of weighing, compounding, and bottling shall wear respirators of the "supplied-air" type.
 4. All ventilating fans shall be arranged so that they may be speeded to three times their normal revolutions per minute for 20 minutes before and after each working period in order to remove dust and radon which may have accumulated in the ducts and in the air of workrooms.
 5. Care must be taken to provide sufficient air intakes so that the room ventilating fan will not create a back pressure on the painting hood suction fan.
 5. **Illumination.** Natural daylight shall be used to the fullest extent for illumination and shall be supplemented by artificial light when necessary. The minimum light allowed is 50 foot candles of diffused light.
 6. **Floors.** Floors shall have smooth, continuous surfaces insofar as possible, of water repellent material, such as painted concrete or linoleum. *Wooden floors are prohibited.* Floors shall be cleaned daily by wet mopping to remove dust without distributing it over the room. *Drysweeping is prohibited.*
 7. **Walls, Ceiling, and Woodwork.** Walls, ceiling, and woodwork should be well painted with a semigloss paint which may be washed occasionally to remove accumulation of dust.
 8. **Painting Equipment**
 - a. **RACKS.** A convenient rack shall be provided for brushes, styluses, stirring rods, and other implements not in use so that they will not be placed on the table top, causing the bristle portion of the brush, tip of the stylus, etc., to come in contact with anything about the work table.
 - b. **WIPING PAPERS.** Solvents in a suitable container and small wiping papers for cleaning these implements shall be provided. Wiping papers shall be used only once and shall then be placed in covered containers provided with a paper bag liner.
 - c. **REFUSE.** The containers for discarded wipers shall be removed at least once each day

and the contents permanently disposed of, outside the workrooms, by burning or returning to the manufacturer of radioactive luminous compound for reclaiming the radium.

d. **HANDLING WASTE.** Under no circumstances are the hands to be brought into contact with the waste being disposed of. A suitable notice to this effect should be placed directly on the waste can for the information of personnel.

e. **POINTING BRUSHES.** Cloth is not suitable for wiping and pointing brushes and shall not be used. *Under no circumstances shall the brush be pointed by use of the lips.*

9. Drying Cabinets

a. **EXHAUST SYSTEM.** Cabinets for drying completed work shall be connected with a suction exhaust system to the outside air.

b. **VENTILATION.** The ventilating system of the cabinet shall be so designed that there will be a uniform air movement of approximately 100 linear feet per minute at the face of the cabinet when the doors are opened.

c. **AVOIDING CONTAMINATION.** Finished work shall be removed to drying cabinets promptly so that radon and vapors (often toxic) will not accumulate near the painting table.

Subsection D

MONITORING AND DECONTAMINATION

19301 GENERAL

Procedures for monitoring and decontamination must be developed and followed at every activity where particulate radioactive contamination is possible. These procedures must be rigid enough to ensure that the maximum intensity of radiation in a given situation is never exceeded.

1. **Frequency of Monitoring.** Monitoring of radioactive areas shall be done at regular, special, or emergency intervals, as determined by one or more members of the Radiological Defense Staff. (See NavMed P-1325 for a full explanation of the Radiological Defense Staff.)

2. **Records.** Records shall be kept of all monitoring and decontamination procedures.

3. **Supervision.** Decontamination procedures, except personnel decontamination, shall be carried out under the supervision of a qualified Radiological Safety Officer.

4. **Sources for Procedures.** Information concerning specific decontamination procedures may be obtained from *Bureau of Yards and Docks*, TP-PL-2, Atomic Warfare Defense and Radiological Manual.

19302 DECONTAMINATION OF PERSONNEL AND WORK AREA

1. **The Change Station.** A typical "change station" for the more hazardous operations shall be organized and operated as follows:

a. **ROOMS.** A noncontaminated locker room shall be provided where workers may remove their street clothing. They are to proceed to a "clean" room situated adjacent to the check-in desk and film badge shelves. The "clean" room will contain lockers for their work clothing. Necessary equipment, including protective clothing and film badges, will be issued here. A special dressing room on the contaminated side is to be reserved for personnel returning from work who may be contaminated.

b. **EQUIPMENT.** A suitable container shall be provided in the room reserved for returning personnel in which disposable gloves and "bootees" are to be placed. Film badges and all other equipment are to be turned in at this time for monitoring and decontamination. Contaminated clothing will be deposited for laundering.

c. **BATHING FACILITIES.** Handwashing facilities, including brushes for scrubbing the nails, shall be provided on the contaminated side. In addition, showers and monitoring area shall be provided in the passageway between the contaminated and clean areas. After scrubbing the hands, personnel will proceed to the shower. Paying particular attention to the hair and scalp, they are to soap and rinse thoroughly. They will dry themselves in the shower room and then be monitored, with special attention being given to the hair, nostrils, hands, and soles of the feet. Showers are to be repeated

until contamination has been removed or lowered to at least 0.002 r/h or less, beta plus gamma, and until no alpha contamination remains as specified in 19302-4d.

d. **HEAD FACILITIES.** Head facilities are to be provided on both the clean and contaminated sides of the change station. It is not necessary that complete personnel decontamination be carried out prior to using such facilities. The worker should roll his sleeves to the elbow, remove his gloves, and thoroughly scrub his forearms and hands before utilizing these facilities. Head facilities are to be monitored daily.

2. Change Station Decontamination

a. **CHANGE STATION PROPER.** If the level of total radiation is more than 0.05 r per 24 hours, beta plus gamma, or if alpha contamination is detectable in any amount, the change station shall be decontaminated.

b. **SEWAGE SYSTEM.** After a change station has been in use for a short time, shower and laundry drains, etc. become increasing contaminated. It is suggested that, where appropriate, the station be established aboard a barge or lighter. At present, it is considered safe to allow waste water to drain into the harbor. A lighter could be moored in the immediate vicinity of a contaminated vessel for greater convenience of personnel.

3. **Protection of Overhead Personnel.** "Overhead personnel" are workers whose duties are the care of change stations, laundries, and other similar activities which require contact with contaminated material. Overhead personnel shall be provided with film badges and dosimeters. They shall be monitored and decontaminated as if they were working in a radioactive area.

4. Equipment Decontamination

a. LAUNDERING

(1) *Special Facilities.* In order that regular laundry facilities, which are normally not monitored, will not become significantly contaminated, work clothing which is to be laundered and which reads over 0.005 r per working day of beta plus gamma, or is contaminated with an alpha-emitting substance, shall be laundered in a special facility subject to routine monitoring. If, after repeated laundering, contaminated clothing still reads over 0.005 r, beta

plus gamma, per working day, or contains any detectable alpha-emitting substance, it shall be disposed of properly.

(2) *Storing for Decontamination Purposes.* Certain activities may find it economical to appropriately store washed clothing that is still contaminated with isotopes suspected of being relatively short-lived, thereby taking advantage of the decay factor in decontamination. Clothing which does not decay below the permissible level in approximately 6 months should be disposed of properly.

b. **MACHINERY, TOOLS, AND OTHER EQUIPMENT.** Machinery and equipment, such as hand tools, used in contaminated areas shall be monitored and decontaminated if the radiation level is above 0.015 r per 24 hours, gamma plus beta, or if alpha contamination is present. If such equipment cannot be rendered safe by decontamination, it will be properly safeguarded or disposed of, as appropriate.

c. **VEHICLES.** Vehicles used for transporting radioactive material should be carefully monitored.

1. The use of wooden-bed trucks and passenger vehicles should be avoided.
2. Truck beds, carts, and other carriers may be covered with a tarpaulin or canvas before receiving material from radioactive areas or ships.
3. These protective covers may be reused until they become contaminated by alpha emitters or have a level of 0.05 r per 24 hours, gamma plus beta, at which time they shall be disposed of by sinking at sea. If these covers are in short supply, the possibility of decontamination should be considered.
4. Surfaces of small boats which may become contaminated shall also be monitored and decontaminated as necessary.

d. **DRYDOCKS.** Drydocks in which work has been done on contaminated ships shall be frequently monitored. The MPE limit for areas, fittings, and equipment of the drydock is established at 0.015 r per 24 hours, gamma plus beta. There must be no alpha radiation detectable by suitable low-level alpha meters. Areas and materials reading in excess of this level shall be decontaminated.

19303 WASTE DISPOSAL

All contaminated debris must be collected and properly disposed of.

1. Radioisotopes. Radioisotopes may be discharged into main sewers in small amounts when properly diluted, provided the quantities recommended by the Atomic Energy Commission and the National Committee on Radiation Protection are not exceeded. In particular, amounts of Iodine 131 may be discharged in small increments totaling not more than 10 millicuries per day in institutions or systems having a dry-weather flow of 1 million gallons per day at the treatment plants. In amounts greater than 10 millicuries per day, the disposal should be through either a constant-head orifice device or a constant-drip discharge bottle. Using a uniform-discharge device, 100 millicuries of these isotopes may be discharged in a 6-hour daylight period into a system having the above daily average dry-weather flow. Permissible dosages for other sewage flows will be proportional, and all limits are subject to revision at a particular activity on the basis of actual radioactive measurements in the sludges.

2. Radioactive Phosphorus and Iodine. Radioactive phosphorus may be discharged into the sewer in the same quantities and by the same procedures as radioactive iodine. In the diagnostic and therapeutic use of P^{32} , as well as the diagnostic use of I^{131} , and the treatment of hyperthyroidism with I^{131} , patients may

use the toilet facilities without instructions.

3. Radioactive Carbon. Radioactive carbon may be discharged into the air as $C^{14}O_2$ in concentrations equal to or less than 10^{-6} microcurie per cc. of air. C^{14} in the form of particulate matter should not be discharged into the air.

4. Ship Decontamination Waste. Acids and other waste materials which have been used to decontaminate a ship's saltwater system or other equipment shall be placed in suitable containers and dumped at sea. Care shall be taken to avoid spilling such waste materials en route.

5. Beta- or Gamma-Emitting Materials. Radioactive materials which emit beta or gamma radiation may be buried in the earth to a depth of 5 feet or more in a suitable, selected area which is in possession of, and will be maintained by, the user or a contracting agency. Burial in the earth is satisfactory, but disposal at sea is preferred.

6. Alpha-Emitting Waste Material. Alpha-emitting waste material will be buried in accordance with the procedures of the Atomic Energy Commission. In general, sealed, watertight, metal drums containing the alpha waste will be imbedded in concrete at least 5 feet from the surface of the ground and away from possible drainage to any water supply.

7. Dumping at Sea. In general, dumping at sea may be substituted for burial, as described in 5 and 6, provided that sealed containers are used and are buried at least 200 miles from shore in relatively unfrequented traffic lanes.

Section 3

TRANSPORTATION OF RADIOACTIVE MATERIALS

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Subsection A

CLASSIFICATION

19401 INTRODUCTION

The transportation of radioactive materials must be subject to regulation so that personnel will not be exposed to any radiation in excess of the maximum permissible exposure levels set forth in section 1 of this chapter. When radioactive materials are shipped via public carriers, public health hazards are involved and maximum precautions must be followed just as in a work area.

The material in subsection B is taken from the Interstate Commerce Commission's Regulations for Transportation of Explosives and Other Dangerous Articles, which should be studied when further details are required. These regulations are constantly being revised and shippers are cautioned to be sure to follow the regulations which are in effect at the time shipment is made. Subsections C and D briefly summarize regulations of the Civil Aeronautics Board and of the United States Postmaster General.

19402 MATERIALS COVERED BY THESE REQUIREMENTS

Radioactive materials (liquid, solid, or gaseous; manufactured articles such as instrument or clock dials of which radioactive materials are a part; luminous compounds; ores and residues) of the following three groups shall be accepted for shipment by air, rail, or postal mailing, provided they follow the requirements of this section:

1. **Group I.** This group consists of radioactive materials that emit gamma rays only or both gamma and electrically charged corpuscular rays.

2. **Group II.** Group II consists of radioactive materials that emit neutrons and either or both the types of radiation characteristic of Group I materials.

3. **Group III.** This group consists of radioactive materials emitting electrically charged corpuscular rays only, i. e., alpha or beta, etc. It also includes packages so shielded that the

gamma radiation at the surface of the package does not exceed 10 milliroentgens for 24 hours at any time during transportation.

19403 EXEMPTIONS

Radioactive materials are exempt from prescribed packing, marking, and labeling requirements provided they fulfill all of the following conditions:

1. **Nonleakage.** The package must be such that there can be no leakage of radioactive material under normal conditions of transportation.

2. **Quantity.** The package must contain not more than 0.1 millicurie of radium, or polonium, or that amount of strontium 89, strontium 90, or barium 140 which disintegrates at a rate of more than 5 million atoms per second, or that amount of any other radioactive substance which disintegrates at a rate of more than 50 million atoms per second.

3. **Securely Packed.** The package must be such that no significant alpha, beta, or neutron radiation is emitted from the exterior, and gamma radiation at any surface must be less than 10 milliroentgens for 24 hours.

4. **Manufactured Articles.** Manufactured articles other than liquids, such as instrument or clock dials of which radioactive materials are a component part, and luminous compounds

when securely packed in strong outside containers are exempt from specification packing, marking, and labeling requirements provided the gamma radiation at any surface of the package is less than 10 mr. in 24 hours.

5. **Ores and Residues.** Radioactive materials such as ores, residues, etc., of low activity packed in strong tight containers are exempt from specification packing and labeling requirements for shipment in carload lots by rail freight provided the gamma radiation or equivalent will not exceed 10 mr. per hour at a distance of 12 feet from any surface of the car and that the gamma radiation or equivalent will not exceed 10 mr. per hour at a distance of 5 feet from either end surface of the car. There must be no loose radioactive material in the car, and the shipment must be braced so as to prevent leakage or shift of lading under conditions normally incident to transportation. The car must be placarded by the shipper as prescribed in this section, and shipments must be loaded by consignor and unloaded by consignee.

6. **AEC Escort.** Shipments of radioactive materials made by the Atomic Energy Commission or under its direction or supervision, which are *escorted* by personnel especially designated by the AEC, are exempt from these regulations.

Subsection B

SHIPMENT BY RAIL FREIGHT, EXPRESS, OR BUS

19421 QUANTITY LIMITATIONS

1. **Single Packages.** The content of a single package of radioactive material shall be limited to the amount prescribed in article 19403,2.

2. Loads

a. **TOTAL UNITS.** Not more than 40 units of radioactive material shall be transported in any car at one time.

b. **TOTAL RADIOACTIVE CONTENT.** Not more than 2,000 millicuries total of radium, polonium, or other members of the radium family of elements, and not more than that amount of any other radioactive substance which disintegrates at the rate of 100,000 million (10^{11}) atoms

per second may be packed in one outside container for shipment via rail.

19422 PACKING AND SHIELDING

Radioactive materials that present special hazards because of their tendency to remain fixed in the human body for long periods of time (radium, plutonium, radioactive strontium, etc.) must, in addition to the packing hereinafter prescribed, be packed in inside metal containers, specification 2R, or other containers approved by the Bureau of Explosives (ICC).

All radioactive materials must be so packed and shielded that the degree of fogging of un-

developed film under conditions normally incident to transportation (24 hours at 15 feet from the package) will not exceed that produced by 11.5 milliroentgens of penetrating gamma rays of radium filtered by $\frac{1}{2}$ inch of lead.

1. Outside Packing

a. **DIMENSIONS.** The smallest dimension of any outside shipping container for radioactive materials must be not less than 4 inches.

b. **DESIGN.** All outside shipping containers must be of such design that the gamma radiation will not exceed 200 milliroentgens per hour or equivalent at any point of readily accessible surface. Containers must be equipped with handles and protective devices when necessary in order to satisfy this requirement, and personnel must carry containers by handles when these are provided.

c. **CONSTRUCTION.** The outside shipping container for any radioactive material, unless specifically exempt as described in article 19403, must be a wooden box specification 15A or 15B, fiber drum specification 21A, or a fiber-board box specification 12B (see ICC Docket No. 3666), except that equally efficient containers may be used when approved by the ICC Bureau of Explosives.

2. Inside Packing

a. **GROUP I.** Radioactive materials, Group I, liquid, solid, or gaseous, must be packed inside containers completely surrounded by a shield of lead or other suitable material. Inside packing must meet the following requirements:

1. The shield must be so designed that it will not open or break under conditions incident to transportation.
2. The minimum shielding must be sufficient to prevent the escape of any primary corpuscular radiation to the exterior of the outside shipping container.
3. It shall be of such thickness that the gamma radiation will not exceed 10 mrhm.

b. **GROUP II.** Radioactive materials, Group II, liquid, solid, or gaseous, must be packed in suitable inside containers completely shielded so that at any time during transportation the radiation measured at right angles to any point on the long axis of the shipping container will not exceed the following limits:

1. Gamma radiation shall not exceed 10 mrhm.
2. Electrically charged corpuscular radiation shall not exceed the physical equivalent of 10 mrhm. of gamma radiation.
3. Neutron radiation shall not exceed the physical equivalent of 2 mrhm. of gamma radiation.
4. If a combination of materials in the above points exists, the combined radiation must not exceed the maximum allowed for any one material.

c. **GROUP III.** Radioactive materials, Group III, liquid, solid, or gaseous, must be packed in suitable inside containers completely wrapped and/or shielded with such material as will prevent the escape of primary corpuscular radiation to the exterior of the shipping container. Secondary radiation at the surface of the container must not exceed 10 mr per 24 hours at any time during transportation.

3. **Packing of Liquids.** Liquids of Groups I, II, and III shall follow the above requirements for both outside packing and for maximum radiation allowed. In addition, the following special precautions shall apply:

a. **CONSTRUCTION OF INSIDE CONTAINER.** Liquid radioactive materials in all groups shall be packed in tight glass, earthenware, or other suitable inside containers.

b. **ABSORBENT PACKING.** The inside containers must be surrounded on all side and within the shield by an absorbent material sufficient to absorb the entire liquid contents and of such nature that its efficiency will not be impaired by chemical reaction with the contents.

c. **ALTERNATE PACKING.** If the inside container is packed in a metal container, specification 2R, or other container approved by the Bureau of Explosives, the absorbent cushioning is not required. Specification 2R requires the following:

1. The outside diameter must be not more than 3 inches and the length not more than 8 inches exclusive of flanges or handling or fastening devices.
2. It must be of stainless steel, malleable iron, or brass having a wall thickness of not less than $\frac{3}{32}$ inch for diameter up

to 2 inches and not less than $\frac{1}{8}$ inch for diameter up to 3 inches.

3. The ends of the tube must be fitted with screw type closures except that one end of the tube may be permanently closed by a weld or brazed plate.
4. Welded or brazed side seams are authorized.
5. Closing devices must be of screw type. The number of threads per inch must be not less than United States Standard pipe threads. Caps or plugs are authorized.

19423 LABELING

All individual packages and all cars containing radioactive material shall be labeled to show the type of material contained therein and the radiation involved, and shall give proper warning to personnel.

1. Packages

a. PACKAGES OF GROUP I OR II MATERIALS. Because of the highly hazardous nature of the radioactive materials in groups I and II, the label is different from that for Group III. It is printed in red on a white background.

b. PACKAGES OF GROUP III MATERIALS. Packages of the less dangerous material, emitting corpuscular rays only, bear a label printed in blue on white.

2. Freight Cars. All vehicles containing shipments of radioactive materials shall bear a warning label, which is printed in red on white and is $10\frac{3}{4}$ inches on each side.

3. Buses. Any motor vehicle (bus or trailer) carrying radioactive material shall be marked or placarded on each side and on the rear as follows:

1. Label shall read:

Dangerous, class D poison
DANGEROUS — RADIOACTIVE
MATERIAL

2. Letters shall be not less than 3 inches high.

3. Letters shall be in marked contrast to the background so that they are easily readable.

4. Replacing and Removing Placards. Placards and car certificates lost in transit shall be replaced at the next inspection point and those no longer required shall be removed.

19424 LOADING

1. General Safety Rules

1. Contents of a load shall be limited as specified in article 19421.
2. Any loose radioactive material must be removed, placed in a closed container in a segregated location, and held for instructions from the shipper.
3. Radioactive materials shall not be loaded in the same vehicle with explosives.
4. A car containing radioactive materials shall not be handled next to a car containing explosives or next to a car containing undeveloped film.
5. Loads shall be arranged so as to avoid spillage and scattering of loose material.

2. Minimum Distance Requirements. No person shall unnecessarily remain in a car containing radioactive material, and loads shall be arranged to give maximum protection to personnel and to passengers. The following rules apply:

a. DISTANCE FROM OCCUPIED AREAS. A container of radioactive material shall not be placed closer than 3 feet to an area which may be continuously occupied by passengers, employees, or shipments of animals. When more than one container is present the distance from occupied areas shall be computed from the table below.

b. COMBINATION CAR. In a combination car carrying both passengers and express shipments, a container must not be placed closer than 3 feet to the dividing partition. For the distance for more than one container see the table below.

c. **DISTANCE FROM UNDEVELOPED FILM.** Radioactive material (one package) must not be placed closer than 15 feet to any package of undeveloped film. For distance for more than one container see table below.

Total units* of radioactive material	Minimum distance to personnel or to a dividing partition (feet)	Minimum distance to nearest undeveloped film (feet)
1 to 10 -----	3	15
11 to 20 -----	4	20
21 to 30 -----	5	25
31 to 40 -----	6	30

* One unit equals 1 milliroentgen per hour at 1 meter for hard gamma radiation or the amount of radiation which has the same effect on film as 1 mrhm. of hard gamma rays of radium filtered by $\frac{1}{2}$ inch of lead.

19425 ACCIDENTS

In case of fire, wreck, breakage, or unusual delay involving any shipment of radioactive material the following precautions shall be taken:

1. The package of radioactive material, any loose radioactive material, and the car itself shall be segregated as far as possible from human contact.
2. In case of breakage where the inside container may be damaged, great care must be exercised to prevent contact with or inhalation of radioactive material, or any other means by which such materials can enter the body.
3. No person shall be allowed to remain close to the car or contents until qualified persons are available to supervise handling.
4. Cars, building areas, or equipment in which radioactive material has been spilled must not be again placed in service or occupied until decontaminated by qualified persons.

5. Any accident of any kind involving radioactive material shall be immediately reported to the shipper and to the Bureau of Explosives of the ICC.

19426 DECONTAMINATION

When shipped as empty, all containers and accessories previously used for shipments of radioactive materials must be decontaminated to sufficient extent to conform to the conditions prescribed in Article 19403. Decontamination of all areas shall be carried out by trained personnel.

19427 STORAGE OF RADIOACTIVE MATERIALS

1. **Maximum Amount.** Not more than 40 units of radioactive material shall be stored in a terminal at one time.

2. **Time Limitation.** If for any reason a package containing radioactive materials would otherwise remain in the same building for a period longer than 24 hours it must be moved to a different location after each 24 hours.

3. **Storage Containers.** Beta-gamma sources should be stored in closed containers with sufficient shielding so that the radiation level is less than 12.5 milliroentgens per hour on contact. A much lower radiation level, preferably 1 to 2 milliroentgens per hour, is desirable if practical.

19428 MOTOR VEHICLE RESTRICTIONS

No motor carrier may transport any radioactive material poison, class D, requiring red or blue radioactive material label, under these regulations in or on any bus while engaged in the transportation of passengers except where no other practicable means of transportation is available. When shipment must be made by bus, packing, handling, and loading shall be in accordance with the requirements above for shipment by rail.

Subsection C

TRANSPORTATION BY AIR

19431 GENERAL SHIPPING REQUIREMENTS

Transportation of radioactive materials by air involves also the transport of the material at some points (to and from the plane, etc.)

by other means. Therefore, regulations of this section conform in general with those for shipping by rail. The following regulations also apply.

1. **Materials.** Radioactive materials of groups I, II, and III shall be accepted for shipment when they are packed, marked, and labeled in accordance with the regulations of this chapter.

2. **Certification.** No shipper shall offer and no air carrier or other operator of aircraft shall accept radioactive materials for carriage by air unless the shipper certifies that the shipment complies with these requirements. No shipment shall be accepted for transportation by passenger-carrying aircraft unless the package shows a clear and visible statement that it is within the limitations prescribed for passenger operation.

3. **Pilot Notification.** When radioactive materials are carried on aircraft the pilot shall be notified of the proper shipping name of the article, the type of label, quantity, and location.

4. **Exemptions.** The exemptions listed in article 19403 shall supply to shipments by air.

19432 PERSONNEL MONITORING

1. **Personnel on Plane.** When radioactive materials are being shipped by plane it shall be the responsibility of the shipper and the carrier to monitor all personnel involved to insure that the accepted limits of personnel radiation exposure are not exceeded.

2. **Loading and Unloading.** It shall be the responsibility of the consignor or the consignee to supervise all loading and unloading operations and to monitor all personnel involved to insure that maximum permissible exposures are not exceeded.

19433 QUANTITY LIMITS

The quantity limit for shipment by air shall be the same as that for shipment by rail (Article 19421), except that there is no quantity limit for shipment of radioactive materials of Group III.

19434 PACKING, LOADING, AND LABELING

1. **Packing.** Single packages shall be packed as required in Article 19422, except that when liquids are packed for shipment by plane the

containers must be sufficient in strength to prevent any leakage or distortion caused by change in temperature or altitude. This requirement is in addition to the requirements of Article 19422.

2. Loading

a. **CARGO LOCATION.** Articles acceptable for cargo aircraft shall be carried in accessible cargo pits or bins or in the cabin. If radioactive materials are being carried on passenger-carrying aircraft, however, they shall *not* be stored in the cabin.

b. **DISTANCE REQUIREMENTS.** A container or group of containers of radioactive material shall not be placed closer than the distance specified in the table below to any area continuously occupied by crew members or passengers:

Total number of units	Minimum distance to crew members and passengers (feet)
0-2.....	1
3-5.....	2
6-10.....	3
11-20.....	4
21-30.....	5
31-40.....	6

Unit—number found on the red label which marks package.

c. **PROXIMITY TO EXPLOSIVES.** A container of radioactive material shall not be loaded next to explosive material in a cabin or in the same cargo pit or bin with explosive material.

d. **RADIATION INTENSITY.** Radiation intensity shall not exceed 10 mr. per hour of gamma radiation or equivalent at one meter from any outside surface of the load (as loaded in place in the airplane).

e. **BRACING.** The shipment shall be braced and lashed so as to prevent leakage, and there shall be no loose radioactive material in the airplane.

3. **Marking Containers.** All containers of radioactive material to be shipped by plane must be marked in accordance with the provisions of Article 19423.

19435 ACCIDENTS

1. Appearance of Possible Damage. If any package of radioactive material to be shipped by plane appears to be damaged, leaking, or improperly marked and labeled, it shall be removed from the aircraft and shall not be returned to transportation by air until it has been determined that its contents comply with the requirements of this section.

2. Damage. Any damaged shipment of radioactive material shall be removed from transportation and segregated as far as possible from human contact. The shipper shall immediately be contacted for disposal instructions, and the Administrator or the Board shall also be notified.

3. Spillage. Whenever there is any actual spillage of radioactive materials of such nature that the materials are no longer contained within their inner containers, no attempt shall be made to remove or clean up the materials until instructions are received from the shipper or other qualified persons, and then only when necessary protective measures have been taken, and qualified persons are present to supervise the handling.

Subsection D**POSTAL MAILING OF RADIOACTIVE MATERIALS****19441 ACCEPTABLE MATERIALS**

Because of the conditions of mailing—i. e., the fact that packages of radioactive material must be put in mail sacks and handled in the same way as other mail—definite restrictions are placed on acceptable materials for postal mailing.

1. Types of Material. Liquid, solid or gaseous radioactive materials, manufactured articles, luminous compounds, ores and residues of any of the three groups of radioactive material may be mailed if they fulfill the conditions of this section.

2. Contents. The package must contain not more than 0.1 millicurie of radium, or polonium, or that amount of strontium 89, strontium 90, or barium 140 which disintegrates at the rate of more than 5 million atoms per second, or that amount of any other radioactive substance which disintegrates at the rate of more than 50 million atoms per second.

3. Maximum Radiation. The package must be such that no significant alpha, beta, or neutron radiation is emitted from the exterior of the package, and the gamma radiation at any surface of the package must be less than 10 mr. for 24 hours.

4. Package. The package must be designed and prepared so that there will be no significant radioactive surface contamination of any part of the container.

19442 PACKING

Packing of radioactive materials for postal mailing shall be in accordance with the requirements of Article 19422, Packing and Shielding. Special attention shall be given to the following:

1. The package must be such that there can be no leakage of radioactive material under conditions normally incident to transportation in the mails in sacks.
2. Liquids must be packed in tight glass, earthenware, or other suitable inside containers surrounded by an absorbent material sufficient to absorb the entire liquid contents and of such nature that the efficiency will not be impaired by chemical reaction with the contents.

19443 LABELING

Shipments must be labeled as follows:

RADIOACTIVE MATERIAL

Gamma Radiation at Surface of Parcel
Less than 10 Milliroentgens for 24
Hours—No Significant Alpha, Beta, or
Neutron Radiation.

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United States Navy
SAFETY PRECAUTIONS

Chapter 20
ORDNANCE

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Precautions to be Observed in Handling, Fuzing,
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General, 20101**Ammunition Handling and Stowage, 20102****Service of Guns, Including Ammunition Supply, 20103****Precautions to be Observed in Handling, Fuzing, or Inserting Detonators in Explosive Ordnance, 20104****Torpedoes, Torpedo Air Flasks, and Accessories, 20105****Miscellaneous Ordnance Safety Precautions, 20106****20101 GENERAL**

1. **Scope.** To avoid danger of casualties, the observance of the following safety precautions is mandatory. The Bureau of Ordnance shall be informed of any circumstances which conflict with these safety precautions or which for any other reason require changes in or additions to them.

2. **Interpretation.** When in doubt as to the exact meaning of a safety precaution, an interpretation shall be requested from the Bureau of Ordnance. Conditions not covered by these safety precautions may arise which, in the opinion of the commanding officer, may render further operation of the equipment unsafe. Under these conditions, nothing in these safety precautions shall be construed as authorizing such further operation.

3. **Safety Devices.** Safety devices provided shall always be used as designated to prevent possibility of accident, and shall be kept in good order and operative at all times. All instructions promulgated by competent authority to insure safe operation or handling of equipment shall be strictly observed.

4. **Safety Watch for Moving Units.** Whenever any motion of power-driven unit is capable of inflicting injury on personnel or material not continuously visible to the person controlling such motion, the officer or petty officer who authorizes the unit to be moved by power shall, except at general quarters, insure that a safety watch is maintained in areas where such injury is possible both outside and inside the unit, and shall have telephone or other effective voice communication established and maintained between the station controlling the

unit and the safety watch. These precautions are applicable to turrets, gun mounts, guns, directors, range finders, searchlights, torpedo tubes, rocket launchers, and similar units. Under the conditions stated above, the station controlling shall obtain a report "all clear" from each safety watch before starting the unit. Each safety watch shall keep his assigned area clear and if unable to do so shall immediately report his unit fouled, and the controlling station shall promptly stop the unit until it is again reported clear.

5. **Warning Signal.** In turrets and enclosed mounts, a warning signal shall be installed outside the turret or mount; and whenever power train is used, except at general quarters, the officer or petty officer in charge of the turret or mount shall cause warning signals to be sounded before using power and at intervals during its use.

6. **Changes in Material.** Changes, modifications in, or additions to ordnance material, or other material used in connection therewith, shall not be made without explicit authority from the bureaus concerned.

7. **Designated Use of Explosives.** No ammunition or explosive assembly shall be used in any gun or appliance for which it is not designated.

8. **Drill Ammunition.** No other than drill ammunition shall be used for drill.

9. **Safety Link.** On guns equipped with hydro-pneumatic counter-recoil systems, the safety link, locking the gun to the slide, shall be connected up at all times except when firing or when testing and overhauling the counter-recoil systems or when a battery is in a condition of readiness for action.

10. AA Firing. Except in action or when specifically authorized, antiaircraft guns shall not be fired at elevations greater than, or fuze settings less than, those prescribed in the current orders for Gunnery Exercises. When firing antiaircraft guns as such, all personnel not required to be exposed shall be kept under cover.

20102 AMMUNITION HANDLING AND STOWAGE

1. Supervision. As familiarity with any work, no matter how dangerous, is apt to lead to carelessness, all persons who may supervise or perform work in connection with the inspection, care, preparation, use, or handling of ammunition or explosives have the following responsibility:

1. They shall exercise the utmost care that all regulations and instructions are rigidly observed.
2. They shall carefully supervise those under them and frequently warn them of the necessity of using the utmost precaution in the performance of their work. No relaxation of vigilance shall ever be permitted.

2. Fueling Operations. Except in case of emergency, ammunition shall not be transferred during fueling operations.

3. High Temperatures. All ammunition, explosives, and powder shall be protected from abnormally high temperature. If so exposed, they shall be handled in accordance with current instructions of the Bureau of Ordnance. Permissible maximum storage temperatures shall be prescribed by the Bureau of Ordnance.

4. Smokeless Powder

a. WHEN WET. Smokeless powder which has been wet from any cause whatever must be regarded as dangerous for dry storage. Such powder shall be handled in accordance with current instructions of the Bureau of Ordnance.

b. DECOMPOSED. Smokeless powder which shows unmistakable signs of advanced decomposition shall be disposed of in accordance with current instructions of the Bureau of Ordnance.

5. Handling. To minimize the risk of fire, explosion, and damage to ammunition and its containers from accidental causes, ammunition shall be handled as little as practicable. As the action of denting thin-cased high-explosive ammunition is known to have caused detonation of the explosive in some instances, special care shall be exercised to insure that such ammunition is never struck, dropped, or bumped.

6. Defective Ammunition. Defective bomb type and thin-case ammunition shall be disposed of in accordance with current instructions of the Bureau of Ordnance.

7. Fuzed Projectiles

a. DROPPING. A fuzed projectile, whether in a container or not, if dropped from a height exceeding 5 feet shall be dumped overboard in a manner conforming with regulations for dumping ammunition at sea except when practicable to turn the projectile into a Naval Ammunition Depot. Such ammunition shall be handled with the greatest care.

b. STRIKING. Care must be used to avoid tapping or otherwise striking fuzed projectiles. This precaution is particularly applicable to attempts to loosen such a projectile in the cartridge case by repeated light blows of a mallet, unloading such a projectile wedged in the bore of a gun, and the striking of a projectile by the recoil of a gun or an ejected case.

8. Switches. The covers of switches, circuit breakers, etc., shall be kept securely closed while powder is exposed in the vicinity.

9. Magazines

a. CLEAN AND DRY. Magazines shall be kept scrupulously clean and dry at all times. Nothing shall be stored in magazines except explosives, containers, and authorized magazine equipment. Particular attention shall be paid that no oily rags, waste, or other foreign materials susceptible to spontaneous ignition are stored in them.

b. NAKED LIGHT. Naked lights, matches, or other flame-producing apparatus shall never be taken into magazines or other spaces used primarily as magazines while these compartments contain explosives.

c. EXCESSIVE HEAT. Before performing any work which may cause either an abnormally high temperature or an intense local heat in

a magazine or other compartment used primarily as a magazine, all explosives shall be removed to safe storage until normal conditions have been restored.

10. Black Powder. Black powder is one of the most dangerous of explosives and shall always be kept by itself. Only such quantities as will meet immediate needs shall be taken from the magazines. A container of black powder shall never be opened in a magazine nor in the vicinity of a container in which there is any explosive.

11. Altering Ammunition. Ammunition shall not be altered, nor shall fuzes or any other parts be removed or disassembled without explicit instructions from the Bureau of Ordnance.

20103 SERVICE OF GUNS, INCLUDING AMMUNITION SUPPLY

1. Trial Loading. Live ammunition shall be loaded into guns for firing purposes only. Test or inspection of ammunition by fitting it into guns is prohibited, except when authorized by specific instructions of the Bureau of Ordnance.

2. Immediate Requirements

a. DURING FIRING. No other ammunition than that immediately required shall be permitted to remain outside of the magazine.

b. DURING GUNNERY EXERCISES. Charges in excess of the amount required to be available for one run shall not be assembled in the vicinity of guns mounted outside of turrets. No charge for a bag gun shall be removed from its tank, nor shall the tops of tanks be removed or so loosened that the bags may be exposed to flame until immediately before the charge is required for loading.

3. Keeping Stages Closed. When either cartridges or bag charges are outside the magazines, each flame-proof compartment or space which forms a stage of the ammunition train, including the magazines and gun compartments (in or out of turrets), shall, wherever practicable, be kept closed from all other compartments or spaces except when the actual passage of ammunition requires it to be open. Where practicable, no flameproof stage of the ammunition train shall be open to both the

preceding and the following stages at the same time.

4. Flame Seals Damaged. If flame seals be damaged during firing, except in action, so that they cannot fulfill their purpose, the gun or guns concerned shall cease firing until the flame seals are again effective.

5. One Charge Per Gun

a. REMOVING POWDER FROM TANKS. In a magazine or handling room in which powder is removed from tanks to be sent to the guns in bags, not more than one charge per gun, for the guns being served by that magazine or handling room, shall be exposed by removal from tanks, by removal of tank tops, or by so loosening the tank tops that the bags may be exposed to flame.

b. SEPARATE STAGES. In each subsequent flameproof stage of the ammunition train, not more than one charge per gun, for the guns being supplied through that stage, shall be allowed to accumulate. For this purpose, the spaces or handling rooms at the tops and bottoms of continuous-chain powder hoists will be considered separate stages (whether or not separated from the hoists by flameproof doors, flaps, or shutters).

c. POWDER HOISTS. In addition to the above, continuous-chain powder hoists may be kept filled; or if hand passing is used, there may be one bag of powder at the station of each man in the train.

d. ADEQUATE SUPPLY. It is the intent of this article to permit sufficient powder to be exposed to provide an adequate supply for the guns being served. The maximum amount specified above should be exposed only if a smaller amount will not assure an adequate supply.

6. After Firing Gun. As there is a flammable gas present in the chamber of a gun after firing, which, under certain conditions, may constitute a danger by igniting the powder charge which is to be used for the next round, and as smoldering remnants of powder bag may also be present, the following precautions shall always be observed:

a. BORE CLEAR. Bag guns shall not be loaded until a member of the crew has assured himself that the bore is clear of powder gases and remnants and has announced "bore clear" either

by voice or by approved signal, such as a hand, whistle, gong, or horn, except that, when the gas-ejector system does not readily clear the bore, the combined sponge and rammer (where provided) may be used. The sponge shall be dipped in water for each load.

b. EXPOSING POWDER. Until the "bore clear" signal above described is given, or the projectile is rammed home with the wet combined sponge and rammer, powder shall not be exposed closer than 4 feet to a gun not mounted in a turret.

c. POWDER IN AMMUNITION CARS. In turrets fitted with ammunition cars, the car and the center of an open breech shall not be allowed within 6 feet of one another until the "bore clear" signal has been given.

d. POWDER IN TURRET CHAMBER. In turrets fitted with continuous-chain powder hoists, or for hand passing, the powder shall not be exposed in the turret chamber, nor shall the flame seal, shutter, or flap between the turret chamber and the next stage in the powder train be opened or unlocked until the "bore clear" signal is given.

7. Broken Powder Bag. If a powder bag is broken to the extent of allowing powder to fall out, the command "Silence" shall be given and the loose powder shall be gathered up. If it is impracticable to utilize this section of the charge satisfactorily in loading, it shall be secured in a flameproof container or immersed in water.

8. Bore Clear Signal. In turrets not fitted with bulkheads between guns, the "bore clear" signal to the turret crew shall not be given until the guns which have been fired and whose breech plugs have been opened are reported clear, at which time one signal to the entire turret crew shall be given.

9. Unseated Projectile. Care shall be exercised to prevent projectiles from slipping back from their seats, as unseated projectiles may cause abnormally high pressure. In bag guns, projectiles shall not be rammed by interposing one or more sections of a powder charge between the head of the rammer and base of the projectile.

10. Wiping Mushroom. The mushroom of every bag gun shall be wiped after each shot

with a sponge or cloth dampened with fresh water.

11. Closing Breech. As soon as a gun is loaded the breech shall be closed without delay.

12. Pushing Primer. When priming a lock of the sliding-wedge type, care shall be taken to insure the primer being pushed in beyond the primer catch to prevent the primer coming out or being crushed by the operation of the wedge in closing.

13. Loading Bag Gun. In loading a bag gun, neither the gun ready light switch nor the gun firing cut-out switch (which are combined in some installations) shall be in the closed position until the breech is fully closed and all personnel are clear of the recoil.

14. Closing Breech. To guard against blowing out primers which may fire at the instant of closure, care shall be taken whenever the breech of a bag gun with a live primer in the lock is being closed, that the operating lever is followed through during the last part of its travel, to prevent any opening of the lock due to rebound.

15. Unlocking Breech Plug. The breech plug of a bag gun shall never be unlocked or opened while there is a live primer in the lock.

16. Opening Firing Lock. A firing lock into which a live primer has been inserted shall never be opened, either independently or by operation of the breech mechanism, unless the firing circuit is broken externally of the lock or breech mechanism (for example, at a local pointer's key or gun captain's ready switch), except when it is known that the loaded gun has fired. This applies to the firing of primers at drill, to the operation of loaded guns, and the examination of primers.

17. Position of Breech. The limiting position of the breech of the gun on recoil shall be indicated and the gun crew shall be instructed to keep clear.

18. Unloading Gun. While a gun is being unloaded, all personnel not required for the unloading operation shall be kept at a safe distance from the gun.

19. Ramming Devices. Only approved ramming devices and methods shall be used in loading live cartridges. Any cartridge which does not freely and fully enter the chamber

of the gun shall be carefully extracted and put aside, and no further attempt shall be made to fire such a cartridge.

20. Breech Plug Closing. In every case gun using primers with a percussion element, except those guns of the sliding-wedge type, the breech plug shall not be closed until the plugman is assured by actually feeling that the front face of the plug is free from any projections, such as a protruding firing pin or fused metal, in order to prevent discharge of the gun when the breech plug is swung to but not rotated.

21. Stowing Fired Cartridge Cases. In order to avoid danger from flammable gases, fired cartridge cases shall, before stowing below, remain in freely circulating open air for at least 10 minutes. If practicable they should be stored on their base.

22. Premature Opening Breech of Loaded Gun. Effective measures shall be taken to guard against prematurely opening the breech of a loaded gun, whether or not the gun is fitted with a salvo latch.

23. "Cease Fire" When Gun Is Loaded. If a gun is loaded at the order "cease fire"—

1. The gun shall be kept pointed and trained in a safe direction.
2. The breech mechanism shall be kept fully closed.
3. The gun shall normally be cleared by firing as soon as practicable.

24. Fuzed Projectile in Hot Gun. A loaded and fuzed projectile, seated in the bore of a gun that is hot from previous firing, presents a hazard, since detonation of the projectile is possible as a result of being heated. Whenever practicable, such projectile should be disposed of promptly by firing the round. Whether a gun is hot or cold, the risks attendant upon removing a loaded and fuzed projectile seated in the bore, by backing out, are considered unwarranted except in the case of guns for which existing instructions specifically prescribe this procedure.

25. Hangfire

a. POSSIBILITY OF ACCIDENT. The possibility of a serious accident due to opening the breech of a gun too soon in the case of a hangfire demands the constant exercise of the utmost

prudence and caution. A hangfire must be assumed to exist when:

1. An unsuccessful attempt has been made to fire the gun.
2. A charge remains in a bag gun, with the possibility of ignition by an undetected ember from the previous round.

b. PROCEDURE FOR FIRING. The following procedure shall be followed in the cases noted above:

1. Keep the gun pointed and trained in a safe direction.
2. Keep the breech mechanism fully closed.
3. Continue attempts to fire, if desired, re-priming bag guns provided such efforts do not involve any movement tending to open the breech.

c. PROCEDURE WHEN GUN IS NOT FIRED. If the gun is not fired under the above conditions:

1. Open the firing key and break the firing circuit elsewhere.
2. Unhook the firing lanyard, if detachable.
3. Remove the primer from the lock of a bag gun, using the primer tools supplied for this purpose, taking care to avoid danger from recoil or blowback. For this purpose, or for shifting primers, do not leave the firing lock open longer than necessary.
4. Do not open the breech for 30 minutes (10 minutes for field and landing guns on shore) after the last attempt to fire. This, at the discretion of the commanding officer, is not obligatory in time of action; nor is it obligatory or advisable with a hot gun if an instruction of the Bureau of Ordnance to prevent a projectile "cook-off" recommends earlier opening of the breech when the gun cannot otherwise be cleared by firing it.

d. NEVER LEAVE A LOADED GUN. The crew shall never leave a loaded gun until the precautions in (b) and (c) 1 to 3 above have been carried out.

e. DISPOSING OF AMMUNITION. Ammunition removed from a loaded gun shall be disposed of in accordance with current instructions of the Bureau of Ordnance.

26. Obstructed Line of Fire. Ships shall cease the firing of any gun whose line of fire is

endangering any objects other than the designated target. These objects include friendly ships and aircraft and own ship's structure together with the mounts and launchers and their barrels, fixed or moving. This stipulation applies to objects in the vicinity of the firing point, throughout the trajectory and in the vicinity of the target. Turrets, mounts, guns and launchers which are not firing, while others are firing, shall be trained and elevated if manned, or secured if unmanned, in a manner that will provide the greatest amount of safety from the firing. This position of greatest amount of safety of the unmanned mounts will generally be that position which the firing cut-out mechanism cams of the firing mounts were cut to clear.

20104 PRECAUTIONS TO BE OBSERVED IN HANDLING, FUZING, OR INSERTING DETONATORS IN EXPLOSIVE ORDNANCE

1. **Armed Ammunition.** Since it is not always possible to ascertain readily whether mines, depth charges, rockets, projector charges, and aircraft bombs have been inadvertently armed in storage or handling, all of these types, when fuzed or assembled with firing mechanisms, shall at all times be handled and treated as if armed, in strict conformity with the instructions for safeguarding against the inadvertent arming, firing, or launching of such ammunition.

2. **Inserting Fuzes.** Certain types of bombs, mines, depth charges, rockets, and projector charges are normally issued unfuzed. Fuzes shall not be inserted in such ammunition (nor in the case of fuzes having separate detonators, shall the detonators be inserted into the fuzes) until just prior to placing in ready stowage, or just prior to or after loading the ammunition on the racks, launchers, or projectors preparatory to dropping or launching. Such fuzing or inserting of detonators shall not be accomplished in or near a magazine or ready service stowage, but may be accomplished in handling rooms or spaces specially designated for such purposes by competent authority. In general, fuzing or inserting of detonators shall be done on individual rounds isolated from other ammunition insofar as practicable.

3. **Resetting Fuzes.** Fuzes which have been set shall be reset to the safe position before sending them below.

4. **Work Involving Fuzes and Firing Devices.** Fuzes, firing mechanisms, or primer mechanisms for bombs, depth charges, rockets, projector charges, demolition outfits, or mines shall not, except as covered by special orders or current instructions of the Bureau of Ordnance, be removed, disassembled, repaired, or in any way altered.

5. Stowing Fuzes

a. **NEAR EXPLOSIVES.** Bombs, rocket heads, and projector charges, for which fuzes are issued separately, shall not be stowed with those fuzes installed in or near magazines containing explosives.

b. **CONTAINING INTEGRAL DETONATORS.** Fuzes issued separately for bombs, rockets, and projector charges, which contain integral detonators or other explosive components, shall be stored only in specially designated fuze magazines which shall not be located adjacent to magazines containing high explosives.

6. **Stowing Detonators.** Detonators which are not assembled integrally with fuzes shall be stored only in standard type detonator lockers located in approved places.

7. **Removing Fuze-Arming Devices.** Fuze-arming wires or devices shall not be removed from the unarmed position until just before releasing or firing. Safety pins or other devices requiring removal before flight, or firing, shall not be removed until the ammunition has been loaded in racks, projectors, or launchers and not until after the arming wire or device has been put in place. Bombs, mines, depth charges, rockets or projector charges not expended shall be made "safe" at the first opportunity in accordance with current instructions for the respective assemblies. When handling or unarming an accidentally armed fuze, the prescribed procedure shall be carefully followed.

8. **Electronic Components, Including Electric Igniters, Detonators, and Fuzes.** Electric igniters, primers, or detonators, electrically fired rocket and guided missile motors, electric or electronic ordnance fuzes, including VT fuzes, shall not be stowed in the same compartment with,

or be exposed within five feet of, any exposed electronic transmitting apparatus or exposed antenna or antenna lead, except where such electronic apparatus or antenna is a part of authorized test equipment of a weapon or is integral with a weapon containing such components, in which event special instructions pertinent thereto shall apply.

20105 TORPEDOES, TORPEDO AIR FLASKS, AND ACCESSORIES

1. Torpedo Air Flasks

a. **PRESSURE.** Torpedo air flasks shall never be charged to more than 100 pounds above the prescribed working pressure. When the prescribed working pressure is for any reason altered, the new pressure designated shall be stamped on the flask near the charging valve.

b. **COOLING.** The artificial cooling of torpedo air flasks during or after charging by spraying with water or by flooding the torpedoes in the tubes is prohibited.

c. **CUTTING.** Any cutting of torpedo air flasks, accumulators, piping, or other receptacles for compressed air is prohibited.

d. **TRANSPORTING WHEN CHARGED.** Torpedo air flasks in a fully charged condition shall not be transported, hoisted from one deck to another, struck below, etc., except when it is not possible to perform the operation efficiently and expeditiously with the air flasks partially charged.

2. **Recovering Torpedo.** In recovering a torpedo in the water the propeller lock shall be put on at the first opportunity and kept on until the torpedo is safely landed.

3. **Torpedo Torch Pots.** Because the filling material used in torpedo torch pots ignites spontaneously or forms poisonous gas when combined with water, or subjected to moisture, extreme care must be taken to follow existing Bureau of Ordnance instructions concerning the handling of torch pots.

4. **Electric Torpedoes.** The use of electric torpedoes involves hazards of mechanical injuries, electrical shock or burn, acid burns, and hydrogen explosion or combustion. Bureau of Ordnance instructions prescribe effective measures to prevent accidents and shall be rigidly adhered to at all times.

20106 MISCELLANEOUS ORDNANCE SAFETY PRECAUTIONS

1. **Catapult Guns.** Current instructions prescribe effective measures for the safe employment, operation, and service of catapults and their guns. In addition, all safety precautions pertaining to guns and ammunition, unless manifestly inapplicable, apply to catapult guns and their ammunition.

2. **Smoke-Making Devices.** Smoke-making devices which misfire or have been in the water shall not be taken on board ship or inside buildings or structures on shore. Gas masks shall be worn when entering concentrated smoke clouds.

3. **Chemical Ammunition.** All personnel working with chemical ammunition shall be trained in the fundamentals of handling toxic chemicals and shall be familiar with the instructions pertaining thereto. They shall use adequate and effective equipment, including protective clothing and gas masks.

4. **Pyrotechnic Material.** Pyrotechnic material shall always be kept by itself in regular pyrotechnic storage spaces, if such are provided, or in pyrotechnic lockers on upper decks. In using it, only a minimum amount shall be exposed.

5. **Path of Rocket Exhaust.** All personnel shall keep clear of the possible exhaust path of rockets at all times.

6. **Testing Rocket Launchers.** Launcher-firing circuits shall not be tested when rockets are in the launchers.

7. **Rocket Misfires.** In case of rocket misfire, personnel shall not approach the rocket for at least 10 minutes, nor until firing circuits are known to be open. This, at the discretion of the commanding officer, is not obligatory in time of action.

8. **Demolition Material Misfires.** When a misfire occurs in handling demolition material, an ample margin of time shall be allowed before investigating the reason of misfire. A period of 30 minutes after the longest predictable delay has elapsed is considered ample.

9. **Blow-Back.** In firing small arms, machine guns, and submachine guns, whenever a blow-back occurs, the bore shall be examined for foul bore before firing another round.

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United States Navy
SAFETY PRECAUTIONS

Chapter 21
MEDICAL FACILITIES

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Section I
MEDICAL LABORATORIES

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21101 LABORATORY HAZARDS

The instructions of this section are intended as a guide for personnel who work in medical laboratories. While engaged in the performance of their duties, pathologists, technicians, and others have contracted serious infections. Some of these workers also have suffered from injuries, burns, poisons, and harmful gases. Usually, these conditions are due to carelessness on the part of the person involved and can be prevented by taking certain precautionary measures. The object of these instructions is to point out the essential precautions that should be taken by laboratory personnel while handling or working with infectious materials, sharp instruments, dangerous chemicals, and harmful gases.

21102 PATHOLOGICAL LABORATORIES

1. **The Autopsy.** Although most of the bodies which are received in the morgue may not be infectious, it is advisable to treat them as such. An established routine shall be followed by all personnel who are involved in the performance of an autopsy.

a. **RESTRICTION OF PERSONNEL.** Persons detailed in surgical or obstetrical departments shall *not* perform autopsies.

b. **PERSONAL PROTECTION**

(1) *Clothing.* Before beginning an autopsy, the operator and his assistants shall remove their regular clothing and shall dress in a manner to protect themselves and others from such infectious materials as blood, pus, and body fluids which, if carried away on one's uniform

or street clothes, could cause self-infection or infection to outsiders. An outfit which has been found satisfactory in many autopsy rooms consists of a pair of hospital pajamas, covered with a rubber apron, over which is placed a linen apron; a surgical cap and mask and a pair of rubber gloves complete the costume,

(2) *Face Shield.* A laboratory face and eye shield has been found very useful in some laboratories. It is made of clear cellulose plastic, is nonflammable, and can be worn over glasses. It protects the forehead and face against particles of bone, blood, body fluids, pus, etc., during the process of performing an autopsy.

c. **TREATMENT OF INJURY.** If the operator or an assistant should receive a cut or needle prick during an autopsy he should stop work immediately, discard his gloves, wash his hands with soap and water without using a brush, and then treat the injury. Before continuing with his work he should put on another pair of rubber gloves.

d. **CLEANLINESS.** Each individual should try to keep the cadaver, as well as gloves, instruments, linen, and the surrounding working space as clean as possible.

e. **POST-AUTOPSY PROCEDURES**

(1) *Procedures for Operators.* Upon the completion of an autopsy, the operator and his assistants shall remove their gloves and aprons and wash their hands thoroughly with soap and water without using a brush.

(2) *Procedures for Clean-up Man.* Before removing his mask, gloves, aprons, and pajamas, the clean-up man shall take the following precautions:

1. Clean the body.
2. Collect the soiled linen and instruments and place them in the sterilizer or in some disinfectant.
3. Scrub and clean the operating table and other soiled utilities.
4. Sweep, scrub, and swab the deck.

2. Handling Tissue. Unfixed or fresh tissue shall not be allowed to lie about unless first covered with a damp piece of gauze or cloth. Air currents carry small dried particles about in the room, and if infectious materials are permitted to lie around personnel who are working in the vicinity may become infected by the inhalation of these tiny particles.

a. GLOVES. Before handling unfixed tissue, the examiner shall put on a pair of rubber gloves.

b. INFECTIOUS MATERIALS. Special precautions shall be observed when working with tissue or other materials which are suspected of harboring bacteria, rickettsia, viruses, or other pathogenic organisms. Anyone handling such specimens should wear a gown, mask, and rubber gloves.

c. CARE OF INSTRUMENTS. Instruments used during the performance of an autopsy or for the purpose of cutting surgical specimens shall be *washed immediately* with soap and water and then placed in a five percent solution of creosol compound (or some equivalent solution) for a minimum of thirty minutes. After this, they shall be cleaned, dried, and returned to their proper places.

(1) *Bard-Parker Equipment.* If Bard-Parker handles and knife blades are used, the blade must not be attached to the handle until the operator is ready to use the knife. This will prevent many self-inflicted wounds.

(2) *Microtome knives.* When cleaning a microtome knife, always use a soft camel's hair brush and brush toward the edge. Do not try to place the back on a microtome knife unless the handle is attached to the blade.

d. SHIPPING OF SPECIMENS. Tissue specimens shall be packed for shipment in accordance with methods outlined in the Manual of the Armed Forces Institute of Pathology. They shall be so packed as to prevent breakage and a possible resultant spread of infection. They

shall be properly marked, and care shall be taken in opening tissue containers to avoid self-inflicted cuts and infections.

21103 CLINICAL LABORATORIES

1. Care of Personnel. Because of the danger of contamination from infected materials, personnel shall adhere strictly to the following safety rules:

a. SMOKING AND EATING

1. There shall be no smoking while handling infectious material because of the danger of contamination of the cigarette and resultant contamination of the lips and mouth.
2. There shall be no eating in a bacteriology or parasitology laboratory when handling infectious material.
3. Edibles shall not be stored in the laboratory refrigerator.

b. CLOTHING

1. Gowns, rubber gloves, masks, and other protective clothing shall be worn while handling highly infectious material.
2. During culture transfers and inoculations of infectious material, the procedure shall be carried out under cover of a hood.

2. Care of Materials

a. HANDLING

1. Never handle inoculated laboratory animals with ungloved hands.
2. When injecting infectious material, do not clear syringes of air bubbles in the open air; cover tips of needles with cotton soaked with alcohol or some other disinfectant.
3. Treat *all* unknown specimens as infectious.
4. Cultures in petri dishes, flasks, etc., should not be left uncovered longer than is necessary for transfer of the material.

b. TRANSFER OF MATERIAL. Only plugged pipettes should be used for transferring infectious material.

c. DISPOSAL OF MATERIAL. A definite system, such as the one suggested below, should be followed in the disposal of infectious material:

1. Submerge pipettes in cylinders containing disinfectant.

2. Place petri dishes and flasks in covered containers.
3. Autoclave all material, including containers, before handwashing.
4. Incinerate all contaminated flammable material.

3. Clean-Up of Laboratory Area

1. All bench tops and table tops shall be swabbed with disinfectant after each working day.
2. In case of an accident, such as the breaking or dropping of infected containers, the area shall be flooded with disinfectant before attempting to clean it up.

Section 2

HOSPITALS AND DISPENSARIES

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21201 HOUSEKEEPING IN THE HOSPITAL

1. General Safety Rules. Good housekeeping in both indoor and outdoor areas is a long step in the direction of an effective safety program and is a good index of the efficiency of any activity. Among the requirements of good housekeeping are the following:

a. RUBBISH DISPOSAL. Areas are to be kept as clean and orderly as possible, with accumulations of rubbish and waste materials stored in approved containers ready for prompt removal.

b. MAINTENANCE OF GROUNDS. Dry weeds and grasses should not be permitted around buildings or along driveways and railroad properties. Grass should be cut frequently and weeds cut or destroyed by such weed-killer compounds as sodium chlorate, borax, or ammonium sulfate.

c. SNOW AND ICE HAZARDS. Where possible, ice and snow slipping hazards should be prevented by removal of the snow or slush before it solidifies. If this is not practicable, such areas may be made skid-proof by spreading sand, gravel, or fine cinders over the slippery surfaces.

d. CLOTHES LOCKERS. Lockers should be secured, and the tops of such lockers kept clear of stowed material and gear.

e. PROJECTING NAILS. Boards with nails projecting from them must not be left lying around, and nails should be removed from box or keg rims.

f. FLOORS

(1) Cleaning. Wet or oily floors should be promptly dried or cleaned; for cleaning purposes, a noncombustible sweeping compound, rather than sawdust, should be used. Gasoline, acetone, benzene, naphtha, kerosene, paint thinner, turpentine, petroleum spirits, paint remover, flammable solvents, carbon tetra-

chloride, or other chlorinated hydrocarbons shall *not* be used for cleaning floors.

(2) Refinishing. Only nonslip, water emulsion wax shall be used to refinish old floors or to finish new floors. In refinishing, the removal of wax or deck-surface finish shall be accomplished by scraping, sanding, rubbing with an abrasive, or by the use of a nonflammable compound. If it is necessary in exceptional cases to employ small quantities of flammable liquids to remove wax, the following precautions shall be observed.

1. The liquid shall have a flash point of not less than 100° F.
2. The work shall be performed by maintenance forces or painting crews under strict supervision.
3. Work shall be done when as few people as possible are in the area.
4. The main electrical switch for the entire building shall be disengaged and the work done by natural light if possible. When this is not practicable, disconnect all electrical appliances and machines in the vicinity.
5. No smoking shall be allowed in the area where the work is performed.
6. All possible natural ventilation shall be provided by keeping doors and windows open.
7. Only approved safety cans and minimum working quantities of liquid shall be used, and cans must be kept in good condition. Glass containers shall not be used; pouring flammable liquids into glass bottles often generates static and an explosion or fire may result.
8. Closed metal cans for cleaning rags shall be provided, and the contents of cans shall be removed from the building promptly.
9. Personnel shall be familiar with all fire-

fighting equipment. Extra CO₂ or soda-acid portable fire extinguishers shall be provided.

2. Kitchen Safety. Safety in the hospital kitchen requires the same precautions as safety in the kitchens of other establishments. For detailed directions, personnel shall study section 1 of chapter 24, *Commissary, Messing, and Exchange Facilities*. The following additional precautions apply:

1. Do not use unnecessary haste in moving about the kitchens, pantries, workrooms, or any other portion of the hospital.
2. When using the stairways, hold onto the handrail and descend or ascend cautiously. Never run up or down stairs or take more than one stair at a time.
3. Report all injuries or accidents, no matter how slight, for immediate attention.
4. Load the trays of food carts in such a manner that articles will not spill or fall.
5. When pushing food trucks, keep the hands within the confines of the truck and always take care not to strike persons or objects.
6. Lift the covers of steam tables and dish sterilizers from the side, never from the front, where escaping steam can come in contact with the arm.
7. Before cleaning steam tables, sterilizers, dish warmers, and other steam devices, be sure that all steam has been shut off and that the equipment is cool enough to handle.

3. Commissary Safety. Safety in the operation of the commissary depends upon strict adherence to a policy of good housekeeping, proper instruction of employees, and proper maintenance of the plant and its equipment. Study section 1 of chapter 24 for detailed precautions. The following additional precautions shall be observed:

1. Commissary personnel shall be examined physically, at scheduled intervals, for their fitness as food handlers and shall be checked daily for cleanliness by the commissary supervisor.
2. At no time shall a shortage of toilet paper, soap, or towels be allowed in the washrooms used by commissary help.

4. Laundry Safety. Personnel shall study chapter 24, section 2, article 24207 for laundry safety rules.

21202 HANDLING AND STORAGE OF GASES

1. Specifications for Cylinders. All cylinders containing compressed gases, such as anesthetic gases, oxygen, or other gases used for medicinal purposes, whether or not these gases are flammable, shall be in accordance with the regulations of the Interstate Commerce Commission with respect to construction, testing, and fittings. Such cylinders shall be plainly marked with the name of the gas contained therein. Small cylinders, for use on anesthetic machines, shall also bear color markings in accordance with MIL-STD 101. These markings should comply with those recommended by the Division of Simplified Practices, National Bureau of Standards, Washington, D. C.

2. Storage of Cylinders

a. SAFE AREAS FOR STORAGE

1. Cylinders should be stored only in safely constructed rooms. Only cylinders connected to anesthesia machines should be permitted in anesthetizing locations.
2. Cylinders containing compressed gases or cans holding volatile liquids should be kept away from radiators, steam pipes, and like sources of heat.
3. Separate rooms should be used for the storage of oxidizing gases such as oxygen or nitrous oxide, and combustible materials should not be stored or kept near cylinders containing these gases.

b. IDENTIFICATION CHARTS. Locations used for the storage of gases in cylinders should be provided with a chart identifying the various gases according to the colors employed.

3. Handling of Oxygen Cylinders. Great care must be exercised in handling oxygen to prevent contact of oxygen under pressure with oils, greases, organic lubricants, rubber, or other material of an organic nature. The following recommendations of the Compressed Gas Association should be followed closely:

a. GENERAL RESTRICTIONS

1. Never drape an oxygen cylinder with materials such as hospital gowns, masks, or caps.

2. Never mix gases of any type in an oxygen or any other cylinder.
3. Never use oxygen from a cylinder except through a pressure reducing regulator.
4. Never attempt to use regulators which are in need of repair or cylinders having valves which do not operate properly.
5. Never attempt to repair defective oxygen equipment unless properly qualified to do so.

b. PROTECTION FROM LUBRICANTS

1. Never permit oil, grease, or readily combustible materials to come in contact with oxygen cylinders, valves, regulators, gages, or fittings.
2. Never lubricate regulators, fittings, or gages with oil or any other combustible substance.
3. Never handle oxygen cylinders or apparatus with oily hands, greasy gloves, or rags.

c. VALVES AND FITTINGS

1. Never apply a fitting to a cylinder without first cleaning the particles of dust and dirt from the opening to the cylinder by slightly opening and closing the valve.
2. Never bring an anesthesia machine to the patient without first opening the high pressure valve on the oxygen cylinder.
3. Never permit oxygen to enter the regulator suddenly. Open the valve slowly. When opening the valve, point the face of the gage on the regulator away from the operator.
4. Never use oxygen fittings, valves, regulators, or gages for any other service except oxygen.

4. Reference. For additional information on the precautions to be observed in connection with compressed or liquefied gases, see the *Bureau of Ships Manual, Chapter 23, "Industrial Gases."*

21203 X-RAY DEPARTMENT

The following precautions relate to the constructions of X-ray rooms and equipment and their use. For details of maximum permissible exposure see chapter 19, Radiological Safety.

1. X-Ray and Control Rooms. X-ray and con-

trol rooms shall be located in an area free from dampness and with adequate ventilation and light. The control room shall always be so placed in relation to the treatment or examination room that the operator has a clear view of the latter at all times.

2. Installation and Care of X-Ray Equipment

a. CONNECTIONS TO POWER MAINS

1. X-ray installation connections to power mains shall be in accordance with the regulations of the National Electrical Code.
2. Suitable switches shall be inserted in the lines between transformers, rotary converters or motor generators and the X-ray apparatus.
3. All X-ray equipment shall be provided with a quick-acting magnetic overload circuit breaker interposed between the transformer and the supply circuit.
4. High tension generators shall be made inaccessible by means of an insulating barrier or shall be installed in separate rooms.

b. GROUNDING. All metal parts of X-ray equipment, including tube stands, transformers, tanks, motors, and controls, shall be permanently grounded.

c. USE OF X-RAY EQUIPMENT IN ANESTHETIC ROOMS

1. All open high-tension generating equipment shall be located in a well ventilated room which is completely isolated from the anesthetic room, and any connecting doors or windows shall be effectively airtight. (The doors should close against soft rubber or felt padding.)
2. A completely self-contained transformer and X-ray tube unit, in an effectively airtight enclosure, is recommended for use in all anesthetic rooms. Foot switches and all other control devices shall be of a type approved for use in explosive atmospheres. (See the National Electric Code, and National Fire Codes, Volume 1 (1945), published by the National Fire Protection Association, 60 Battery-march St., Boston 10, Mass.)

d. STORAGE OF X-RAY FILM. Only film of the slow-burning or safety-base (cellulose acetate)

type shall be used. This film presents no greater fire hazard than ordinary newsprint paper in the same form. Should it become necessary to use other than the safety type film, the safety regulations of the National Board of Fire Underwriters applying to the use and storage of nitrocellulose films shall be followed.

3. Protection From Direct Radiation

a. X-RAY TUBES. Tubes having built-in protection, or which are in special protective containers, shall be used to replace obsolete installations.

(1) *Enclosure.* The protective enclosure shall surround the X-ray tube bulb and the arms for a distance of four inches from the bulb, so that direct radiation is shielded off in all directions. Open bowls shall not be used. The equivalent of 1.0 mm. of aluminum shall be permanently mounted between the target and the patient in all fluoroscopic-tube enclosures, and 0.5 mm. of aluminum in all radiographic enclosures. Part or all of this aluminum may be contained in the glass of the tube walls. The diaphragm of the tube container shall have a permanent covering of asbestos board at least 0.5 mm. thick placed between the tube and filter, and next to the filter. When the total exposure exceeds previously determined limits, the use of an accumulative timing device is recommended.

(2) *Filter.* In all therapy work, suitable means shall be provided to prevent accidental omission of a filter.

(3) *Applying Tube Voltage.* X-ray tubes in shock-proof containers shall never be handled during an operation. The patient shall be positioned, all details arranged, and the operator out of the room before the tube voltage is applied.

b. PERSONAL PROTECTION

(1) *Clothing.* The medical officer and other X-ray personnel shall be protected from direct radiation.

(2) *Use of Protective Tubes.* Properly and adequately protected tubes and enclosures, as described above, shall be used.

(3) *Control Apparatus.* Control apparatus shall be in an adjacent room. If this is im-

possible the apparatus shall be in a lead-lined booth.

(4) *Protective Screens.* Movable, upright, protective screens are dangerous and should be replaced by more permanent shielding. Careless handling of this type of screen can make it useless. If portable screens are used, great care must be taken to position them properly.

c. EXAMINATIONS. All X-ray protective devices, including wearing apparel, shall be examined at least annually for efficient barrier protection.

d. ROTATION OF PERSONNEL. All persons employed in the X-ray department shall be rotated monthly between duties involving possible exposure and exposure-free work.

4. References. Attention is directed to the following material dealing with the broader aspects of medical X-ray application:

Handbook No. 41, National Bureau of Standards, Washington, D. C.

21204 AMBULANCE SAFETY

1. Equipment. Ambulances shall be in good mechanical condition at all times. All equipment shall be operative and shall be standard according to local practice.

2. Permit. Drivers shall have a United States Navy motor vehicle operator's permit, as required by NCPI 190.10.

3. Briefing of Drivers. Drivers shall be fully conversant with local traffic regulations and local geography. Strict supervision by the transportation officer is essential in this connection.

4. Orders and Accident Forms. Each ambulance shall carry a book or board embodying carefully considered orders and safety precautions prescribed by the local command for the locality, and similar orders shall be posted in the garage. Each ambulance shall carry forms for reporting accidents and the driver shall be instructed as to their use.

5. Observance of State and Local Requirements. All ambulance drivers must satisfy state and municipal requirements as to age and other qualifications.

6. Reference. For further information with regard to transportation by motor vehicle see chapter 4, section 2 of this manual.

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SAFETY PRECAUTIONS

Chapter 22
RESEARCH FACILITIES

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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22101 GENERAL

1. **Regulatory Difficulties.** Laboratory work by its very nature is not readily adaptable to ordinary safeguards and precautions. Much of the work will be in relatively unexplored fields in which the characteristics or behavior of the subject is yet to be determined. The operator of every test or experiment should carefully analyze the procedure to be followed and should take all necessary steps to protect himself and his fellow workers from any possible accident. Where the nature of the work will permit, the practices listed in this chapter are to be followed in the laboratory.

2. **References.** Detailed information on the use of compressed gas cylinders, various hydrocarbons, fuels, cleaners and solvents, radiology, and other subjects related to laboratory work is contained in this publication under the appropriate chapter. No attempt has been made to cover every possible laboratory hazard. Individual laboratories should prepare their own safety precautions to fit specific operations. Chemical laboratories should refer to the *Chemical Safety Data Sheets* published by the Manufacturing Chemists Association of the United States.

3. **Inspection.** Laboratory space and equipment shall be inspected at frequent and regular intervals in an effort to eliminate unsafe conditions and correct unsafe acts before accidents occur. Where new research projects are contemplated, the safety officer should inspect the area to ensure that prescribed safety precautions have been complied with. A formal report should be submitted after each inspection to the person having cognizance over that area.

4. **Housekeeping.** Good housekeeping is essential for the safe operation of all laboratories. Main aisles and exits shall be free from such obstructions as bottles, boxes, etc. Floors should be clean and free from oil, water, and other material which may cause slipping. Equipment, rags, reagents, etc. should be returned to their proper location immediately after use. All containers must be clearly marked and correctly labeled. Waste shall be deposited in metal containers having self-closing covers. Separate containers shall be provided for broken glassware.

5. **Distracting Attention.** Laboratory employees shall pay strict attention to their work. Employees shall avoid unnecessarily distracting other employees. Equipment requiring constant attention shall not be left unattended.

6. **Horseplay.** Horseplay will not be tolerated in any laboratory at any time. Running is forbidden, except in cases of emergency. Liquefied gases, dry ice, air hose, and knives should never be used as playthings.

7. **Procedure in Emergencies.** Definite procedures should be established in each laboratory for the handling of such emergencies as fire, explosion, unexpected release of toxic fumes, etc.

22102 FIRE AND EXPLOSION

1. **Vapors.** Flammable vapors should be as widely separated as possible from sources of ignition.

2. **Extinguishers.** The laboratory should be adequately equipped with fire extinguishers of the type suitable to combat the kind of fire which might be expected to occur. (See ch. 2, sec. 1, for types of fires and extinguishers.)

Laboratory employees should be thoroughly instructed in the use of this equipment.

3. Fire Blankets. Laboratories should be equipped with fire blankets and/or safety showers. Their location should be clearly marked and employees instructed in their use.

4. Quantities of Flammable Liquids. Only the amount of flammable or explosive material that is actually required for the day's work shall be brought into the laboratory.

5. Storage of Flammables

a. IN REFRIGERATORS. Flammable liquids and volatile solvents shall not be stored in refrigerators unless the controls and lights are explosion-proof or are located outside the box. If a low temperature must be maintained in the box to prevent fire or explosion, the box shall be equipped with a signal device to serve as a warning in case of power failure.

b. IN GLASS BOTTLES. A glass bottle shall *not* be used to store more than 1 liter of an individual flammable solvent in the laboratory. Flammable solvents required to be kept in the laboratory, ranging in size from 1 liter to 1 gallon maximum, should be stored in metal containers of the safety type. Highly volatile materials such as ether should not be stored in the laboratory.

c. METAL CABINETS. Flammable liquids used in small quantities in a laboratory should be stored in a metal cabinet.

22103 PERSONAL PROTECTION

1. Clothing. Suitable clothing for laboratory employees shall be worn in accordance with chapter 2, section 2.

2. Goggles. Laboratory employees shall be required to wear protective goggles or protective face shields when there is any possibility of explosion, implosion, violent chemical reaction, splashing chemicals, injurious radiation, or other occurrences hazardous to the eyes.

3. Showers and Fountains. Deluge showers and eye-flush fountains should be provided if exposures encountered point to possible need for them.

22104 LABORATORY EQUIPMENT

1. Standards. Mechanical and electrical equipment in the laboratory shall conform to standards for installation and guarding as outlined elsewhere in these regulations. If the nature of the work is such that it is impracticable to meet these standards, other precautions shall be taken to prevent injury to personnel.

2. Illumination. Illumination shall be adequate for the type of work being performed, as outlined in A. S. A. Code ASA A-11-1942. (See article 02204-5). Electrical fixtures and equipment shall be of such design and so located as not to present fire or explosion hazards.

3. Use of Hoods. Laboratory processes which give off toxic vapors or gas shall be vented outside the laboratory. Flammable vapors and gas shall be vented in such a manner that motors, switches, and lights do not provide a source of ignition. Inhalation of vapors, fumes, gases, and dusts should be avoided by using an efficient fume hood for all work in which such harmful substances are used or formed. A good hood should have air drawn into it at the rate of not less than 100 linear feet per minute. Additional information on ventilation will be found in article 02204.

4. Compressed Gas Cylinders. Compressed gas cylinders shall be stored, handled, and used in accordance with the regulations of chapter 17.

5. Equipment Under Pressure or Vacuum. Equipment under pressure or vacuum shall not be subjected to pressures in excess of that for which it was designed. If the pressure cannot be predetermined or if there is any possibility of rupture, the operator shall be protected by a suitable shield or screen of sufficient strength to protect him from flying material.

6. Laboratory Ovens. Laboratory ovens used to dry samples of explosives or highly flammable materials should have the latches removed from the doors. Chemical compounds or mixtures containing volatile, flammable liquids should be dried in steam ovens only.

22105 ELECTRICAL APPARATUS

1. **Standards.** Electrical equipment in the laboratory shall, where possible, be installed, guarded, and operated in accordance with chapter 18 and shall comply with the requirements of the National Electrical Code.

2. **Repairs.** All electrical wires and apparatus shall be treated as dangerous and must be worked on by qualified personnel only.

3. **Shock.** Precautions should be taken against working in a position in which a shock or slip might place the body of an employee in contact with exposed electrical, energized parts.

4. **Insulated Floor.** Any areas in and around high voltage equipment shall be provided with an insulated floor surface and shall be clearly marked with high voltage warning signs.

5. **Artificial Respiration.** Persons working with or around high voltages should familiarize themselves with artificial respiration methods.

6. **Interlock System.** Where guarding of high voltage equipment cannot be made effective, a suitable interlock system should be used. If the nature of the work is such that an interlock system cannot be used, then personal protective equipment such as rubber gloves, insulated tools, etc. shall be employed with a helper standing by to cut off the power.

7. **Burns.** Do not touch high frequency circuits, as the arcs may cause deep burns.

8. **Connections.** Connections shall not be made or broken while the circuit is energized. Turn the power off first.

9. **High Frequency Fields**

a. **STAY CLEAR.** Do not place parts of the body in strong high frequency fields. They produce heat at a high rate.

b. **JEWELRY.** Rings, watches, bracelets, and other metal objects should not be worn close to high frequency fields as they may become hot in a short period of time.

c. **NO THOROUGHFARE.** Areas in or around high voltage equipment shall not be used for thoroughfares, storage space, or working space.

10. **Cathode Ray Tubes.** Cathode ray tubes must be kept in the original cartons until installed in a piece of equipment. Tube mounting

operations should be isolated to protect other employees and the operators should wear face shields, leather aprons, and gloves.

22106 LABORATORY GLASSWARE

1. **Use of Cork Borer.** Improper or careless handling of a cork borer can result in very painful injury. The borer should be kept sharp and clean and should always be held in such a manner that a slip cannot result in injury. Under no circumstances should the palm of the hand cover the opposite face of a stopper being bored. Hold the stopper firmly with the thumb and forefinger and start the boring with the stopper braced against a soft wooden block or the equivalent. For rubber stoppers, wet the borer cutting edge with glycerine. Rotate the stopper occasionally during the boring to aid in making a perpendicular hole.

2. **Insertion of Tubing in Stopper.** Glass tubing should be inserted in a rubber stopper by using some form of lubricant, such as water or thin grease.

3. **Breaking a Tube.** When breaking a small-bore glass tube or rod it should first be scratched with a file at the point of the desired break. Then, holding the glass in front of the body, with the scratch away from the operator and with the thumbs pressing firmly outward at the point opposite the file scratch, snap quickly with both hands as if snapping a twig. Sharp ends of broken tubing should be fire-polished before using or putting back into stock.

4. **Clamps.** When setting up glass apparatus it should be clamped just tightly enough to support the weight. All parts should be independently supported in line.

5. **Broken Glass.** Broken glass should be immediately picked up and discarded.

6. **Pipetting.** When pipetting or siphoning toxic, corrosive, or unknown solutions, pipettes should be filled by the use of a suction bottle containing bicarbonate solution, by bulb, or by vacuum line. The same equipment should be used when necessary to start a siphon by suction.

22107 CHEMICAL STORAGE

1. **Adequate Space.** The storage room should have adequate aisles, a safe, substantial means of reaching high storage spaces, and adequate illumination for the reading of labels.

2. **Ventilation and Fire Prevention.** A door or window opening directly to the outside should be provided, as well as a blower capable of quickly changing the air in the room. If flammable solvents or explosives are stored, the blower as well as other electrical fixtures should be explosion proof. The room should be provided with a fire door and sprinkler system.

3. **Arrangement of Material.** Heavy items should be stored as close to the floor as possible. Material should not be allowed to project beyond the front of the shelving. Chemicals which will react violently with each other should be stored in spaces as widely separated as may be practical.

4. **Temperature.** Excessive heat or cold should be guarded against where such a condition may cause a reaction.

5. **Labels.** All chemicals shall be plainly labeled. Unless materials found in unlabeled bottles can be properly identified, they should be safely disposed of.

22108 HANDLING CHEMICALS

1. **Mixing.** When mixing acid and water, the acid must always be poured slowly into water, not water into acid. Employees should avoid inhaling acid fumes. Any pouring, mixing, or dispensing of acid shall be in a ventilated sink where running water is available.

2. **Disposal.** Corrosive and volatile liquids shall not be poured down sink drain pipe. If janitors or other nonprofessional workers are to dispose of chemicals they shall be thoroughly instructed in the proper methods and the reason therefor. Separate receptacles shall be provided and clearly marked for broken glass, acids, and inert material. The disposition of highly toxic, explosive, or otherwise hazardous chemicals shall be conducted under the supervision of a competent chemist, as some chemical procedure may be the safest method of disposi-

tion. See *Chemical Safety Data Sheets*, Manufacturing Chemists Association.

3. **Catch Pans.** Catch pans of suitable design and sufficient capacity should be placed beneath stills during distillation, or when large glass beakers are heated, to prevent injury to personnel in case of breakage.

4. **Radioactive Materials.** Laboratory workers handling radioactive materials shall be informed of the hazards involved. The rules outlined in Handbook No. 42, Safe Handling of Radioactive Isotopes, National Bureau of Standards, and those outlined by the Atomic Energy Commission shall be enforced. See chapter 19 of this publication.

5. **Oxidizing Agents.** Strong oxidizing agents must be handled with great care to avoid mixture with easily oxidizable material such as sulphur. When dry, such mixtures are explosive.

22109 HANDLING MERCURY

1. **Mercury Poisoning.** Absorption of mercury or mercury vapor over a period of time, through the skin, nose, or mouth will cause mercury poisoning. Personal cleanliness is of prime importance in eliminating the chances of mercury poisoning. Mercury should never be left around the laboratory in open containers, nor left in sinks, nor on bench tops, nor on the floor when spilled. While the vapor pressure of mercury is relatively low at room temperature its danger to the human system lies in the fact that it is cumulative, and as such is an insidious and dangerous poison. Avoid splashing mercury on hot surfaces since the resulting higher vapor pressure increases the hazard.

2. **Mercury Baths.** Mercury baths used for melting point determinations should be kept in a well-drawing hood, and the operator must be wary of inhaling the fumes.

3. **Spilled Mercury.** Mercury spilled and left in lead-lined sinks will quickly form a lead amalgam which is acid soluble and will soon cause a leak. Spilled mercury should be picked up with a suction hose having a small metal nozzle. Never use an air hose, as this stirs up

harmful mercury dust. Any residual amounts should be dusted with flowers of sulphur. Any equipment containing mercury should be mounted in a shallow steel pan.

4. Floors. Board floors with cracks, floors covered with loose linoleum or other sheet material under which mercury can accumulate, and floors of rough or porous concrete are undesirable in areas where mercury is used, because they are difficult to keep clean.

22110 PERCHLORIC ACID

Laboratory employees using perchloric acid should familiarize themselves with Chemical Safety Data Sheet No. SD-11, "Perchloric Acid Solution," Manufacturing Chemists Association.

22111 METALLIC SODIUM AND POTASSIUM

1. Storage. Metallic sodium and potassium should be stored under kerosene or mineral base oil in tin cans. The cans should be inspected periodically and replaced if evidence of leaks or rusting is found.

2. Disposal. Scrap bits of metallic sodium and potassium should never be discarded in the sink nor thrown into waste cans. Reaction with moisture will cause a fire and violent splattering will result. These metals should be added carefully, in small pieces, to cold alcohol. The employee shall wait until all gas evolution has stopped and the solution is complete before adding more metal. This alcoholate may then be discarded safely in the sink if followed by a generous flow of water.

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United States Navy
SAFETY PRECAUTIONS

Chapter 23
PHOTOGRAPHY

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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CHAPTER 23
PHOTOGRAPHY

Subsection A
THE PHOTOGRAPHIC LABORATORY

23101 PERSONNEL PROTECTION

1. **General.** The safety officer shall determine procedures to prevent serious accidents in the photographic laboratory. He should be familiar with the photographic lab and establish procedures to be followed in it, in case poisoning, burns, or other accidents do occur.

2. **Emergency Treatment Supplies.** In order to facilitate quick and effective action along the lines established by the safety officer, such emergency treatment supplies as may be required shall be in the charge of medical corps personnel.

3. **Protective Clothing.** Approved personal protective clothing or devices shall be used whenever applicable.

4. **Dark Spaces.** When entering or leaving a dark space, proceed slowly and with caution.

5. **Identifying Chemicals.** Never taste chemicals to determine their identity. If the identity of a chemical is doubtful it must be discarded.

6. **Siphoning.** Do not begin siphoning operations by sucking chemicals through tubes.

7. **Inhaling.** Avoid inhaling dust or fumes. Many chemicals, especially those for color work, are toxic.

23102 GENERAL EQUIPMENT

1. **Labels.** All chemical bottles or containers shall be correctly and completely marked or labeled, and special care should be taken to be certain that poisons are so labeled. If a label is accidentally destroyed and there is any doubt as to the contents of a container, the material should be discarded.

2. **Storage**

a. **SHELVES.** Shelves for corrosive chemical storage should be sturdy and provided with

copings to prevent containers from extending over or slipping off the edge.

b. **CHEMICALS.** All chemicals shall be stored in cool, dry, dark spaces. Chemicals that react violently with each other shall be separated to prevent danger of fire or explosion. For example, never store potassium permanganate near glycerine.

3. **Containers**

a. **CORROSIVE CHEMICALS**

(1) **Protection.** Corrosive chemicals should always be kept in thick-walled glass containers which should be protected by wooden frames or boxes. If the container holds five gallons or more, the frame should be supported by a sturdy wooden or metal frame, pivoted or hinged for ease in pouring.

(2) **Lockers.** Corrosive and poisonous chemicals should be stored in lead-lined lockers or boxes and kept locked.

b. **CONCENTRATED ACID.** Concentrated acid may be stored in steel drums and cans for it will not attack steel, but acid diluted with water will attack steel rapidly.

c. **SOLVENTS.** Solvents such as acetone, benzene, chloroform, and gasoline which are not in their original containers should be stored in suitable chemical safety cans.

4. **Glassware.** All glass bottles of 2 gallons or over should be protected by wooden frames.

5. **Electrical Equipment.** Turn off all electrical equipment after use. Some equipment, such as a dry mounting press, remains hot for a considerable period after use. A sign marked *DANGER-HOT* should be plainly visible on the machine when the machine is in use. The sign should not be removed until the machine has cooled.

6. **Paper Trimmers.** The following warning should be stenciled on the face of paper trimmers: *Place blade down.*

Subsection B

PHOTOGRAPHIC SUPPLIES

23201 FILM

1. **Nitrate Film.** Nitrate film is the only film that is highly flammable and under certain conditions explosive. The following precautions should be observed:

a. **STOWAGE.** Nitrate film should be stowed in spaces specifically designed for film stowage with temperature at less than 70° F. and humidity less than 70 percent. In prolonged stowage, the temperature should be maintained at 50° F. and 50 percent humidity. Stowage temperatures of 212° F. and above cause spontaneous ignition. Subjecting nitrate film to a temperature of 300° F. causes immediate ignition, and, when confined, an explosion. Stowage spaces must be equipped with a sprinkler system.

b. **SMOKING LIMIT.** Smoking and the use of open flame is prohibited within 25 feet of the film.

c. **FIRES.** Burning nitrate film generates nitrogen dioxide which is extremely poisonous when inhaled. *Conventional fire-fighting masks are ineffective.* Personnel must stay clear of areas contaminated by such fumes. The most effective extinguishing agent is low pressure discharge carbon dioxide; however, large amounts of water will extinguish the blaze.

2. **Safety Film.** Safety film is very slow burning and not readily combustible. It requires no special handling or stowage.

23202 FLASH EQUIPMENT

1. Photoflash Bulbs

a. **INSPECTION.** Before bulbs are used they should be inspected for damage or deterioration of the plastic safety coating.

b. **STORING.** Photoflash bulbs must not be stored near heat or sources of radiated energy such as VHF or UHF transmitters and radar sets, unless the bulbs are suitably protected by a sheet-copper lined box to reduce the effects of radiation.

c. HANDLING

(1) *Vicinity of radar.* Personnel handling flash bulbs in the vicinity of radar equipment should keep flash bulbs in their cartons until just before using the bulbs.

(2) *Unpackaged bulbs.* Unpackaged bulbs should be handled with gloves.

(3) *Contact points.* Contact points on the bulbs must not be touched to the tongue.

d. PHOTOGRAPHER'S USE

(1) *Bulb shield.* When using flash bulbs within a short distance of personnel subjects, a protective shield should be used in front of the bulb.

(2) *Danger areas.* Photoflash equipment shall not be used inside explosives-loaded rail cars, ship or shore magazines, fuel storage areas, hospital operating rooms, ship holds, or during fueling operations.

2. Photoflash Bombs

a. **HANDLING.** Extreme care shall be exercised in handling these bombs because of their sensitive nature. It is dangerous to attempt to disassemble a photoflash bomb, and no work whatsoever shall be done on a bomb unless the work is performed by a qualified ordnance man.

b. **EYE PROTECTION.** Because of the brilliance of the flash (500,000,000 candlepower), personnel are warned not to watch the explosion.

3. Electronic Flash Equipment

a. **CHARACTERISTICS.** Electronic flash equipment has the same general characteristics as flash bulbs, with the additional danger of sparking of the contact points in the power pack. This equipment is designed to work at a high potential, in most cases at least 2,000 volts. Even after discharge, the condensers contain a large charge of electricity which must be released before any repair work can be done.

b. **SERVICING AND OPERATING.** The following precautions are to be observed when servicing and operating this equipment whether it is in the laboratory or airborne:

1. Only qualified personnel shall service

- high voltage electronic flash equipment.
2. The power cord from the power pack must be disconnected before removing lamp or touching the metal part of the lamp socket.
3. Before batteries are removed, be sure that the assembly has been discharged and the charging switch is not in the charge position.
4. No unit is to be charged for firing unless the flash lamp is installed and the complete assembly is ready for use.
5. If the assembly has been charged but not fired, one hour must elapse before removing the flash lamp.
6. This equipment must not be operated in the presence of explosive vapors.

Subsection C

CHEMICAL HAZARDS

23301 FAMILIARITY WITH PRECAUTIONS

Prior to handling or working with photographic chemicals personnel shall become thoroughly familiar with the detailed precautions for the chemicals involved. A list of the most dangerous photographic chemicals is given in article 23303. Other chemicals, however, may also be hazardous. General rules for emergency treatment given below will be supplemented by the medical officer.

23302 MIXING CHEMICALS

1. **Acid to Water.** Always add acid to water; never add water to acid. The acid should be added slowly and with constant mixing.
2. **Acid and Cyanide.** Never mix an acid and a cyanide, as a lethal gas will be released.
3. **Dissolving Alkalies.** When dissolving strong alkalies such as sodium hydroxide or potassium hydroxide, use cool water.
4. **Pyrex Containers.** Use pyrex glass containers when working with acids. Thick walled glass containers should never be used in mixing chemicals as such glass is more subject to breakage due to temperature charges.

23303 DANGEROUS CHEMICALS

Chemical	Danger	Emergency Treatment
Acetic Acid, Glacial.....	Causes bad burns on contact with skin.	Wash affected areas in floods of water.
Acetone (film cement).....	Fumes are toxic and highly explosive.	Remove patient to fresh air.
Acids (See specific acid on this list).	Burns.....	Wash acid off with large quantities of cold water.
Acids: mineral (as sulfuric, hydrochloric).	Poison.....	Do NOT induce vomiting.
Alcohol (ethyl, methyl and isopropyl).	Flammable.....	
Ammonium Hydroxide.....	Poison	
Carbon Tetrachloride.....	Extremely irritating to eyes and mucous membranes.	Wash with floods of water.
Chrome Alum Potassium....	Extremely toxic fumes.....	Remove patient to <i>fresh air</i> and keep warm, not hot.
Color Developers (Aromatic Amine).	Irritating to nose and skin..	Wash affected areas with copious quantities of warm soap and water.
Cyanides.....	Toxic.....	Wash affected areas liberally with water.
	Deadly poison.....	SPEED IS ESSENTIAL.
		Artificial respiration, if patient is unconscious or breathing with difficulty.

DANGEROUS CHEMICALS—Continued

Chemical	Danger	Emergency Treatment
Dipotassium Monosodium Ferricyanide.	Deadly poison.....	See Cyanides; above.
Formaldehyde.....	Poison..... Suffocating odor. Intense irritant to mucous membranes.	Artificial respiration if necessary.
Hydroquinone.....	Toxic.....	Remove to <i>fresh air</i> .
Hydroxylamine.....	Toxic.....	Wash affected areas in copious amounts of soap and water.
Hydrochloride.....	Can be absorbed by the skin.	
Mercuric Chloride.....	Extremely poisonous..... Extremely dangerous to handle and use.	
Mono Methyl Para Amino-phenol Sulfate (Metol. Elon).	Toxic to skin of some people.	
Nitric Acid.....	Causes painful burns..... Poison.	Wash affected areas with large quantities of soap and water.
Paraformaldehyde.....	Poison, toxic fumes.....	See Trioxymethylene.
Potassium Bichromate.....	Poison.....	
Potassium Ferrocyanide and Ferricyanide.	Poison.....	See Cyanides.
Potassium Hydroxide.....	Poison..... Causes painful burns.	Wash affected areas with water.
Potassium Permanganate.....	Poison..... Combines with glycerine, alcohol, etc. to cause explosive spontaneous combustion.	
Pyrogallie Acid.....	Skin irritant.....	
Silver Nitrate.....	Causes bad burns.....	Wash affected parts with water.
Sodium Carbonate.....	Irritating to eyes and respiratory tract.	Wash in copious amounts of warm water. Irrigate eyes for 15 minutes.
Sodium Cyanide.....	Poison.....	See Cyanides.
Sodium Hydroxide.....	Causes burns..... Poison.	Wash affected areas with floods of water.
Sodium Sulfide.....	Dangerous to eyes..... Fire hazard. In presence of heat or acids gives off hydrogen sulfide which is highly toxic.	Wash eyes with copious amounts of warm water.
Sodium Sulfoyanate.....	Poison.....	See Cyanides.
Sulfuric Acid.....	Corrosive liquid..... Poison.....	Wash affected areas with floods of water, using soap freely. See Acids, Mineral.
Trioxymethylene.....	Poison, toxic fumes.	

Subsection D

MOTION PICTURES

23401 COMMANDING OFFICERS' RESPONSIBILITY

Commanding officers of all ships and stations are directed to require of personnel concerned, by inspection or other appropriate means, full compliance with all safety precautions.

23402 PROJECTION BOOTH

1. Construction

a. OPENINGS. Projection openings should be provided with gravity shutters operated automatically by means of fusible links which are designed to fail at a temperature of 165° F. Fusible links shall be at strategic places in the booth, particularly above each of the film magazines.

b. VENTILATION. The booth should be provided with a mechanical system of ventilation and it should have two escape doors. If rewinding is done in the projection booth the rewind machine should be of an approved enclosed type and nitrocellulose films should not be kept in the booth for a longer time than is required to process and exhibit.

2. Furniture. All equipment and furniture in the booth should be of metal construction.

3. No Smoking. Smoking where film is stowed or exposed is absolutely forbidden. "No Smoking" signs shall be posted in the projection booth.

4. Film Clippings. A pail of water shall be kept in the booth for nitrate clippings. Exposure to sun shining through a port, or any concentrated light carrying heat is often sufficient to ignite loose film.

23403 FILM FIRES

1. During Exhibition. In case of fire during exhibition the following steps should be taken:

1. Quickly pull switches, close douser, and step back.
2. Do not open magazine.
3. After fire has quenched itself, rethread the projector after thoroughly cleaning the sprockets and tension shoes with an approved cleansing agent, and proceed with the exhibition.

2. Stored Film. Nitrocellulose film will spontaneously ignite at a temperature of 212° F. Film shall never be stored where it may be subjected to a high temperature.

23404 EXHIBITION HALLS

1. Doors. All doors of the exhibition hall should open outward and the areas in the vicinity of the exits should be kept clear.

2. Flameproof Curtains. Theater curtains, welding booth curtains, and curtains, draperies, and decorations of all buildings should be flameproofed annually.

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United States Navy
SAFETY PRECAUTIONS

Chapter 24
COMMISSARY, MESSING, AND EXCHANGE FACILITIES

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Section I

COMMISSARY AND MESSING

General, 24101
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24101 GENERAL

1. **Responsibility of Personnel.** It is the responsibility of all personnel to know how to perform assigned duties in a safe manner. The correct way to do a job is the safe way. A person who is not certain as to his particular assignment, or the correct way to do it, should immediately ask his superior to inform him. He should become thoroughly familiar with the safety precautions applicable to his duties and should apply these precautions at all times if it is possible to do so.

2. **Unsafe Conditions.** Unsafe conditions, including damaged and defective equipment, are to be reported to the supervisor without delay. Repairs or replacements should be made as soon as possible.

3. **Clothing Hazards.** Certain kinds of clothing may be accident hazards. Thin or broken soles, high heels, and scarfs, for example, have caused serious, and even fatal, accidents. Personnel should make sure that clothing is safe for a particular task. Open toe shoes and sandals are prohibited, and jewelry must be removed when a person is working near electricity and machinery or when he is handling heavy objects.

4. **Lifting.** When carrying out lifting operations, these rules should be observed:

1. Keep back straight, bend knees, and let leg muscles do the work.
2. Ask for assistance when handling heavy or bulky objects.

3. Never attempt to lift anything when you are in an awkward position.

5. **Climbing.** Only a ladder set at a secure angle should be used for climbing. Ladders are to be equipped with safety feet. Make-shifts shall never be used in place of ladders.

6. **Over-Reaching.** Stretching in order to reach objects may result in strains or falls. Therefore over-reaching is to be avoided.

7. **Running.** Running, except in emergencies, is prohibited.

8. **Horseplay.** Personnel shall not indulge in horseplay or practical jokes. This kind of behavior often leads to injuries.

9. **First Aid.** Employees shall always arrange for first aid treatment to an injury, no matter how slight the injury may be. A scratch, if neglected or improperly attended, can lead to serious consequences.

24102 NAVY EXCHANGE

1. **Stock Arrangement.** Merchandise should be displayed on counters and shelves in such a manner as to achieve the maximum safety for personnel and customers.

a. **STACKING.** Merchandise should be stacked so that there is no danger of its falling. The heaviest items should be placed on the bottom of the stack and the upper items overlapped pyramid fashion. Merchandise is not to protrude beyond the edge of counters or shelves.

b. **REACH-ARMS.** Reach-arms are to be provided so that merchandise on the higher shelves is easily accessible.

c. CLEANING COMPOUNDS. Store cleaning compounds and other caustic solutions in cool, dry areas on lower shelves only.

2. Waste Disposal. Empty boxes and cartons, excelsior, and other waste material is not to be accumulated behind counters, in the aisles, or elsewhere in the store. Waste should be disposed of promptly.

3. Equipment Handling. The following precautions shall be observed in the handling and maintenance of equipment:

1. Do not block the aisles with stools, display racks, stock baskets, stock trucks, or other equipment.
2. Keep shopping carts in good mechanical condition. Do not permit children to ride in shopping carts unless the carts are designed for this purpose.
3. Load stock trucks so that the merchandise will not topple. Push the trucks slowly and return empty trucks to the stockroom immediately.
4. When pin tickets are used for price marking do not leave the pin points exposed. Insert them into the tickets. Do not leave loose pin tickets on the counters.
5. Keep drawers and doors closed when they are not in use.
6. Arrange for repairs to be made as soon as possible on rough edges and splintered areas on equipment.

24103 STOCK ROOM

1. Storing Merchandise. When storing merchandise, the employee should observe the following safety rules:

1. Use shelving of sturdy construction.
2. Wherever possible arrange merchandise so that it is available without moving other merchandise. Always arrange merchandise so that articles likely to be needed first will be easily accessible.
3. Place the heaviest material on the bottom of stacks and overlap the upper material pyramid fashion.
4. Do not stack merchandise so high that it may fall. In the storeroom afloat, merchandise should be secured behind battens

or lashed up if there is danger of its toppling.

5. Do not place merchandise on shelves, in bins, or elsewhere, in such a manner that it protrudes into the aisles.

6. Place flammable materials in lockers or in approved safety cans provided for them. Store the containers on lower shelves only.

2. Ventilation. The stockroom should be properly ventilated if possible. When an employee enters a closed stockroom which has not been properly ventilated, he should arrange for another person to stand outside in case of emergency. The door should remain open. Aboard ship a damage controlman should enter an improperly ventilated storeroom before other personnel are allowed to enter.

3. Securing a Stockroom. It must be determined that everyone is out of a stockroom before it is secured.

4. Repairs. Rough areas, splintered edges, and other such hazardous conditions should be repaired as soon as possible.

5. Smoking. Smoking in stockrooms is prohibited.

24104 RECEIVING ROOM

1. Equipment. The following rules apply to the type and use of equipment in a receiving room:

a. TRUCKS

1. Use hand-trucks or flat-truck for moving heavy cases.
2. Do not attempt to load merchandise on two-wheel hand-trucks without assistance.
3. Do not overload hand-trucks.
4. Never push hand-trucks rapidly or carelessly.
5. Park empty trucks in an area designated for this purpose. Two-wheel hand-trucks should be parked in an upright position.

b. GLOVES. Gloves are to be worn when an employee is handling wooden crates or performing other duties in which there is danger of injury to his hands.

c. GOGGLES. Safety goggles must be worn when cases are being opened for protection

against flying splinters and flying ends of bailing wire or metal stripping.

d. **TOOLS.** Cartons and cases are to be opened with appropriate tools.

1. Cartons which are not to be used again should be opened with a safety carton opener.
2. Cartons which are to be used again should be opened with a spatula-shaped instrument.
3. Cases should be opened with any of the following tools necessary: pinch bars, nail pullers, wire cutters, and steel strapping cutters. Hammers, lather's hatchet, axe, etc., should not be used for opening wood boxes or crates.

2. Unpacking Merchandise. Merchandise shall be unpacked in accordance with the following regulations:

1. Wear gloves when unpacking merchandise.
2. Unpack merchandise as soon as possible after its receipt.
3. Remove protruding nails, staples, and wire from boxes and barrels before unpacking their contents.
4. Beware of broken glass when reaching into packing cases in which glass items have been shipped.
5. Do not pick up broken glass with bare hands.
6. Stack unpacked merchandise in a safe location and in safe piles to prevent its toppling or being trampled.
7. Properly dispose of packing material immediately. Nails, pieces of wire, metal stripping, and other such packing materials may cause injury if dropped on the floor.
8. Stow empty packing cases in a safe manner in an area designated for this purpose.

24105 COMMISSARY

Precautions set forth in the articles on the store, storeroom, and receiving room shall be observed in the commissary when applicable. In addition, other safety precautions are to be followed.

1. Coffee Grinder

1. Place the coffee grinder where it will not be accessible to children.
2. Disconnect the grinder before cleaning it.

2. Dairy Department. Check bottled goods for chips and cracks. Do not sell damaged merchandise.

3. Food Protection. Use display cases to protect food from dirt and insects.

24106 BUTCHER SHOP

1. General. The following general precautions are to be observed in the butcher shop.

a. **CROWDING AND JOSTLING.** Personnel must be careful not to crowd or jostle one another. Crowding and jostling are particularly dangerous in the presence of the cutting instruments and sharp pointed hooks which are found in a butcher shop.

b. **MEAT TRIMMINGS.** In addition to observing general housekeeping precautions, personnel in the butcher shop should be especially careful not to let meat trimmings lie about on the floor. They not only attract flies and insects but create extremely dangerous slipping hazards.

2. Cutting and Slicing Operations. Butchers must pay particularly close attention to their work when using cutting or slicing equipment. The slightest miscalculation or a minor slip can lead to a serious injury.

3. Hand-Operated Tools. The following precautions with reference to hand-operated tools are to be observed:

1. Maintain a complete set of tools at each block so as to avoid unnecessary injuries which may be suffered from carrying the tools about.
2. Keep the handles of tools clean and dry. Greasy or wet handles may cause accidents.
3. Grip instruments firmly.
4. Be sure your fingers are below the guard when using a sharpening steel.
5. Use only sharp knives. Dull knives are greater accident hazards than sharp knives during cutting operations.
6. Never hold a knife in your hand when carrying any other object.

7. Be careful not to lay a piece of meat on a knife. The meat may conceal the cutting edge.
8. Do not place knives in the wash water until ready to wash them. Lay them in plain view beside the sink.
9. When using a cleaver, keep your free hand as far from the path of the cleaver as is necessary to assure safety.
10. Use a hand meat hook when lifting or boning meat.
11. Use a scoop to handle shrimp.
12. Keep the surfaces of meat blocks level.
13. Store tools in their proper places.

4. **Electrically Operated Equipment.** Precautions relating to electrically operated equipment are set forth in chapter 18 of *Safety Precautions*. In addition to those, the following specific precautions are to be observed when using electrically operated machines in the butcher shop:

a. **POWER MEAT SAW**

1. Adjust the blade before the machine is started.
2. Do not twist the blade while operating the machine.
3. Never leave the machine running when it is not in use. Turn it off immediately upon completion of the cutting operation.
4. Disconnect the machine before cleaning it.

b. **ELECTRIC MEAT GRINDER**

1. Adjust the cutter before the power is turned on.
2. Never feed the machine entirely by hand; use a pusher-stick.
3. Do not attempt to remove anything from the machine while the machine is running.
4. Disconnect the machine before cleaning it.

c. **CUBE STEAK MACHINE**

1. Do not permit your hand to get too near the feed slot when feeding meat into the machine.
2. Disconnect the machine before cleaning it.

d. **SLICING MACHINE**

1. Adjust the blade for size of cut before turning on the power.

2. Make sure all guards are secured before operating the machine. Never use the slicer when the blade guard is off.
3. Do not operate the machine with wet hands.
4. Keep your hands away from the blade when the machine is running.
5. Never put your hands under the guard on the slicer.
6. Disconnect the machine before cleaning it.
7. Use a cloth on a stick to clean the blade. Wipe from the center of the blade toward the cutting edge.

5. **Other Equipment**

a. **"WALK-IN" BOXES**

1. Do not enter freezing rooms without proper clothing.
2. The signal light which signifies whether anyone is in the box shall be checked daily to determine that it is in working order.
3. Report immediately any evidence of escaping refrigerator gas.
4. Do not carry objects which are large enough to obscure your view.
5. Be careful not to snag yourself on meat hooks.

b. **DISPLAY CASES**

1. Maintain proper temperature in refrigerated display cases.
2. Report immediately leaks or loose connections.
3. Be sure that electrical refrigeration compressors are grounded.

24107 GALLEY

1. **General**

a. **MARKING OF DOORS.** Mark double swinging doors "IN" and "OUT". Use the correct door and pass through slowly.

b. **HANDLING OF HOT FOODS AND LIQUIDS**

1. Do not allow the handles of cooking utensils to extend beyond the edge of the range. They can be bumped and serious burns to personnel result from spilled food or liquid.
2. Before removing foods from hot ranges and ovens be sure there is a clear place on which to set them.

3. Use only the proper implements, such as pot holders and tongs, for handling hot foods.
4. Carry hot liquids in covered containers with the covers securely in place.
5. Do not bump into anyone when hot food is being carried.
6. Mop up immediately grease which is spilled on the floor. Greasy floors are doubly hazardous. They can cause fires as well as falls.

c. PROPER USE AND CARE OF UTENSILS

1. Use only the proper implements for opening cans and other containers.
2. Hold knives firmly. This cannot be done if the handles are wet or greasy.
3. Knives are to be kept in a drawer designated for this purpose only. The handles should be kept to the front and the cutting edges should face in one direction.
4. Keep utensils and other implements in their proper places when they are not in use.

2. Equipment

a. RANGES AND OVENS

1. Be sure that jets on gas ranges and ovens are fully lit when in use and are turned off when not in use.
2. Open the dampers on oil-fired or gas-fired ranges when these ranges are not in use. Be sure dampers are opened before lighting off.
3. Do not allow grease to collect anywhere on ranges or ovens. Greasy ranges and ovens are serious fire hazards. Dirty ranges and ovens can be partly avoided by using utensils of proper size, by regulating the flame to prevent boiling over, and by careful handling of utensils to prevent spilling.
4. In case of fire in a range or oven immediately call the Fire Department. Then use available portable carbon dioxide (CO₂) or dry chemical extinguishers on the blaze.
5. Do not attempt to clean ranges and ovens while they are hot.
6. Never clean electrically operated ranges and ovens with water. Severe shock may be suffered.

b. VEGETABLE CHOPPER

1. Make certain that the bowl is seated properly and that the chopping blade and guard are secure before starting the machine.
2. Do not attempt to remove produce which has lodged between the blade and the housing until the machine is turned off and the blade has stopped revolving.

c. POTATO PEELER

1. Never operate the peeler unless water has been properly applied.
2. Do not put your hand in the machine while the machine is running.
3. Do not adjust the peeler unless the power has been shut off.

d. FOOD CUTTER

1. Be sure that the knives are in proper position and the guard is securely in place before starting the machine.
2. Do not put your hands in the bowl while the knives are revolving.

e. FOOD CHOPPER

1. Feed the food chopper with a wooden push stick; never feed it with your hands.
2. Keep the same knife and plate together, as they wear to fit each other. Improperly fitted knives can break and fly off the machine.

f. FOOD MIXING BOWL

1. Properly attach the mixing bowl before starting the machine.
2. Keep your hands away from the mixing chamber while the machine is in operation.

g. DOUGH MIXER

1. Be sure the mixing tub and the wire whip are seated properly before starting the machine.
2. Do not put your hands in the mixing tub while the machine is in operation.

h. STEAM-JACKETED KETTLE

1. Determine that the safety valve is in proper working order before using the kettle.
2. Do not tamper with the safety valve or tie it closed. It is there to prevent the kettle from exploding.

i. PRESSURE COOKER

1. Be sure that the safety devices are in proper working order before using the cooker.
2. See that the cover is securely in place before turning on the heat.

j. DEEP FAT FRYER

1. Never allow the temperature of the fat to exceed 400°F. Overheating the fat may cause combustion.
2. Use implements provided for handling foods in deep fat fryers.
3. Avoid spattering hot fat.
4. Wipe up spilled fat immediately.

k. GRILL

1. Do not allow grease to accumulate on the the cooking area of the grill.
 2. Use only the tools provided for turning food and removing it from the grill.
 3. Maintain proper exhaust ventilation. The proper ventilation cannot be maintained if grease is permitted to collect in the exhaust. Clean the exhaust semi-monthly.
 4. Do not permit excessive grease to accumulate in the grease disposal trough.
 5. Be sure that burners are fully lit when in use and are turned off when not in use.
3. **Food Preparation.** The sanitary handling, preparation, and storage of food is an important safety procedure in the galley. The following precautions must be observed to keep food hazards to a minimum:

a. PERSONAL CLEANLINESS AND HANDLING

1. Observe personal cleanliness at all times. Particular care should be taken to keep your hands clean. Finger nails should be short. A cook's hat is to be worn at all times during the preparation and serving of food.
2. Do not touch food with your hands unless necessary. Use appropriate implements for handling food when possible.
3. Never handle food when you have an infection of any kind on your hands or arms. If you develop a sore throat, cold, intestinal disturbance, or symptoms of other general disease, report to your supervisor at once.

b. STORING OF FOOD

1. Cover food when possible.
2. Avoid food spoilage by keeping the food either very hot or very cold so that bacteria cannot multiply. **CAUTION:** Some foods do not change in appearance, odor, or taste when they are tainted. If there is any doubt as to whether food is spoiled, discard it. Do not taste it.
3. Particular care must be taken with these foods: meat and meat products, gravies, milk, custards, and all foods with a high protein content. Foods of this type spoil or curdle quickly and must be discarded if there is any question as to their freshness.
4. When it is possible to do so, thaw frozen meats and poultry in chill box. If meat is thawed at room temperature, precautions must be taken to reduce the time between thawing, cutting, and cooking to a minimum.
5. When storing warm, ground, or diced meats in the chill box, insure quick cooling by placing them in pans no deeper than 6 inches. Line the pans with paper to prevent their coming in contact with the meat.

c. COOKING

1. Thoroughly cook pork, turkey, and veal. They are likely to contain harmful micro-organisms.
2. Prepare hash just before it is to be served. Preparation in advance is dangerous.

d. USE OF CANNED FOODS

1. Closely inspect dented cans for pinholing.
2. Discard cans that are bulged or contain holes.
3. Cook canned vegetables thoroughly, no matter how they are to be served.

e. SERVING AND CLEARING FOOD

1. Keep areas where food is prepared and served free of vermin.
2. Do not wash or store clothes in area where food is prepared or served.
3. Dispose of scraps and waste material at once.
4. Place garbage cans in the coolest possible area.

f. DISHWASHING

1. Keep equipment clean. Inspect equipment for cleanliness before it is used.
2. Use only the proper dishwashing compounds. Suds-forming soap leaves a film on dishes in which bacteria multiply rapidly. Dishes must be rinsed.
3. Clean the dishwashing machine after use. Keep it free from grease, scale, and food particles.

24108 MESS**1. Use and Care of Equipment****a. STEAM TABLE**

1. Use the proper implements, such as pot holders and tongs, for handling the containers.
2. Tilt containers away from you when inserting them into the wells.

b. COFFEE URN

1. Keep hot water to the safe level indicated by the gauge on the urn.
2. Be sure that the safety valve is in proper working condition.

c. FOUNTAIN. Use duck-boards between the fountain and the back bar area if it is possible to do so.

d. ICE CREAM FREEZER UNIT WITH CABINET

1. Never run hot water into any cold freezer.
2. Lock the switch in the "off" position before cleaning the mixing drum.

e. VENDING MACHINES

1. Electric vending machines must be grounded.
2. Keep vending machines clean.
3. Report defective machines promptly.
4. If refrigeration unit has failed to operate for as long as 4 hours, check food for spoilage. If there is doubt as to whether the food is good, it should be discarded.
5. Dispose of broken bottles immediately. Empty bottles should be placed in nearby cases provided for that purpose.
6. Use a hand-truck or other wheeled vehicle to lessen exertion and strain when transporting cases of bottles.

7. Stack cases in such a manner as to avoid toppling and tripping hazards.
8. The areas around vending machines should be policed frequently to make certain these precautions are being observed.

24109 SCULLERY**1. Dishes**

1. Do not stack glassware and dishes so high that there is danger of their toppling.
2. Never pick up broken glassware and dishes with bare hands.
3. Immediately place broken pieces in containers provided for that purpose.
4. Do not load silverware baskets too heavily for safe handling.
5. Do not expose your hands to dishwashing solution. It is a strongly alkaline preparation which is unsuitable for laundry or personal use.

2. Equipment**a. PRE-RINSING MACHINE**

1. Keep hands outside the hopper while the machine is in operation.
2. Watch for sharp edges which may occur on the strainer, and make the necessary repairs.

b. DISHWASHING MACHINE

1. Be sure vent supply is in proper working condition.
2. See that thermostatic controls are functioning properly.
3. Maintain the temperature of the wash water at not less than 120° F. or more than 140° F.
4. Never allow the minimum temperature of the rinse water to fall below 180° F.
5. Keep the side door closed while the machine is operating.
6. Do not place your hands in the machine while the steam is on.
7. Exercise care in feeding the machine to prevent hands from getting caught in the conveyor.

Section 2

EXCHANGE FACILITIES

Cobbler Shop, 24201
Tailor Shop, 24202
Dry Cleaning Shop, 24203
Barber Shop, 24204

Beauty Shop, 24205
Watch Repair Shop, 24206
Laundry, 24207

24201 COBBLER SHOP

1. General Care

1. Keep floors and passageways free of supplies and scraps at all times.
2. Store tools in their proper places when they are not in use.
3. Use caution when handling rubber cement. It is highly flammable. Only the minimum amount required should be kept in the shop. Containers are to be kept covered.
4. Suitable seats shall be provided for employees who are engaged in work that can be performed while seated.

2. Machinery

a. RULES APPLICABLE TO ALL MACHINERY

1. Inspect machinery each morning before beginning operations to determine whether it is in satisfactory working condition.
2. Permit only assigned maintenance personnel to repair machinery.
3. Never operate equipment at a speed in excess of that prescribed by the manufacturer.
4. Revolving shafts and couplings, pulleys, belts, gears, sprockets, chains, and friction drives should be encased or protected by guards.

b. STITCHER

1. When starting the stitcher, push the wheel with the open palm. Never grasp the wheel.
2. Stand to the right of the shoe guide.
3. Face must be kept at a safe distance from the work table and away from the presser-foot handle.

4. Fingers must be kept clear of the gears, presser-foot, and flywheel while the machine is in operation.
5. When sewing, do not grasp the vamp in order to pull the upper away from the welt, as the awl may pierce the fingers. If it is necessary to pull the upper away from the welt, stop the machine. Before starting the machine again, be sure fingers are not too close to the welt.
6. When threading the machine, or when making adjustments and repairs, shut off the motor and turn the wheel by hand.

c. FINISHING MACHINE

1. Be sure cutters are tightly secured before the machine is started.
2. Make certain the exhaust is turned on before trimming operations are begun.
3. Do not hold fingers too close to the part which is being trimmed or sanded.
4. Wear protective goggles for trimming and sanding operations.
5. Hold the shoe firmly during trimming and sanding operations.
6. Shut off the motor before changing wheels, sandpaper, and emery cloths. Before the power is turned on again, be sure the wheels are locked in place.
7. Clean dust collectors daily. The suction of collectors should be strong enough to eliminate flying dust particles which might get into the eyes.
8. Sleeves should be rolled up to the elbow so that they will not be caught in the machinery.

d. ROUGH ROUNDER

1. Check safety guards on cutting knives before using the machine to see that they are secured in the proper position.
2. Never make adjustments or repairs when the switch is in the "on" position.

e. SANDERS

1. Keep hoods down on sanders and heel resting canes at all times.
2. Be sure that sanding wheels are securely locked after replacing sandpaper.

24202 TAILOR SHOP**1. General Care**

1. Store flammable solvents in approved safety vessels. Not more than one gallon of solvent shall be open at one time.
2. Keep areas used for the storage of tailoring work in sanitary condition.

2. Machines**a. PRESSING MACHINE**

1. Do not allow anyone to stand near enough to the press to receive steam burns.
2. Do not place hands on the buck while the steam is being applied or while the head is being lowered.
3. Avoid the application of too much steam. Pressure should be kept to 60-65 pounds when the machine is in operation.
4. Never bring the head down on the buck while trying to smooth out garments.
5. Release the head when the press is not in use.
6. Be sure that no one is standing at either end of the press when the head is to be released.
7. Know the location of the main steam valves. In an emergency, these valves are to be closed.

b. PUFF IRON

1. Hands must be kept off the puff iron while the steam is being applied.
2. Hold clothing being ironed in such a manner that hands will be at least 6 inches from the iron.

c. SEWING MACHINE

1. Safety-type sewing tables with no exposed shafting and pulleys are recommended. Where it is impossible to inclose

shafting, belting, and pulleys, skirt boards fastened under the table will usually protect operator's feet and legs from striking moving parts. All main drive belts, gears, and pulleys should be well guarded.

2. The sewing machine should be equipped with a permanent guard so that the operator's fingers cannot pass under the needle. The machine should not be used at any time unless the guard is in place.
3. Never touch the shuttle-carrier or the flywheel while the machine is in operation.

d. ROTARY AND VERTICAL CLOTH CUTTERS

1. The revolving or reciprocating blades should be equipped with an adjustable guard in front of the cutting edge. This guard should always be set so that there is a minimum of the cutting edge exposed during normal operation.
2. The power should always be disconnected when the machines are not in use.

24203 DRY CLEANING SHOP

For detailed information as to precautionary measures to be used in the dry cleaning shop study the National Fire Protection Association (NFPA) pamphlet No. 32, *Dry Cleaning*, which is the standard and approved guide on this subject. This pamphlet is available at about 35 cents from NFPA Headquarters, 60 Batterymarch St., Boston 10, Mass. Observe also the following precautions:

1. Ventilation and Humidity

a. INSPECTION OF VENTILATING SYSTEM. Before any cleaning operations are performed inspect the ventilating system to determine that it is operating properly. A complete change of air should be provided once every 6 minutes.

b. VAPOR CONCENTRATION. In a dry cleaning shop which uses synthetic solvent, adequate ventilation must be provided to prevent danger from the toxic and flammable nature of solvent vapors.

c. INSURING PROPER HUMIDITY. The psychrometer shall be read at least hourly to insure that the proper humidity (not less than 60%) is maintained.

2. Protection to Personnel

1. Cleaning solutions are not to be used for personal cleanliness.
2. Food must not be taken into rooms where cleaning machines or tumblers are located.
3. Sleeping in the dry cleaning shop is prohibited.
4. Sprinkling of clothes by mouth is prohibited.
5. A first aid kit shall be supplied to the dry cleaning shop afloat. At least one person in the shop should know how to administer first aid.
3. **General Inspection.** Steam and other fire extinguishing systems, including valves and piping, should be inspected monthly. Steam lines should be tested annually.

4. Equipment**a. GENERAL CARE**

1. Only approved equipment with explosion-proof motors and other fire-protection features shall be used.
2. Grounding systems shall be inspected and tested once a month and necessary repairs made immediately.
3. Gauge glasses and sight glasses are to be protected against mechanical injury. They should be inspected daily for damage. The breaking of these glasses permits flammable liquid to escape.
4. Gauge shut-off valves shall be maintained in full operative condition at all times.
5. Washers, extractors, treating tanks, clarifiers, separators, and stills should be liquid-tight. When splashing or leaking of solvent from those machines is discovered, repairs should be made immediately.
6. Washing machines, extractors, scrubbing tables, and scrubbing tubs that utilize flammable liquids shall have return pipe lines not less than 1½ inches in diameter, provided with a liquid seal trap, and arranged so that the flammable liquids can be returned by gravity to the underground tanks.
7. Use automatic means for closing covers of washing machines and drying tumblers.

8. Scouring or brushing tables should have liquid-tight tops with curbs at least one inch high on all sides.
9. Lint and refuse are to be removed from traps and placed in approved waste cans. Waste materials should be removed from the premises at the close of business each day.

b. ELECTRICAL EQUIPMENT

1. Light fixtures, wiring, motors, and all other electrical accessories shall comply with Class I, Group D, hazardous locations, as defined in the National Electrical Code.
2. Safeguard electrical equipment. Static electricity is a special hazard because of the nature of the machines used in a dry cleaning shop.

c. WASHING MACHINE

1. Before using the washing machine, check the interlocks to the cylinder to be sure that they are working properly. Be sure the cylinder is in a locked position during loading and unloading.
2. The outer shell doors should have automatic controls so that the doors will close in case of fire or other emergency.
3. The outer shell doors should be splash-tight.
4. Dry cleaning machines should be kept closed except when they are being loaded or unloaded.

d. EXTRACTOR. Before using the extractor, inspect the interlocking devices. These must be in proper working order to prevent the cover from being opened while the basket is in motion and to prevent the basket from turning while the top is open.

e. CONVEYOR

1. The conveyor should be constructed in such a manner as to prevent flammable liquids from dripping on the floor when guards are being moved from washing machine to extractors.
2. A portable conveyor should be equipped with wooden or fiber-rimmed wheels or wooden shoes to prevent mechanical or static sparks.

3. Portable containers used as conveyors for the transportation of goods from the washing machines to the extractors should be kept free of flammable liquids.

f. TUMBLER

1. Interlocks should be inspected before tumblers are used to insure that the cylinders will remain locked when the machines are being loaded or unloaded.
2. Goods are to be removed from the drying tumbler after the drying process is finished to prevent spontaneous ignition or combustion.
3. A drying tumbler should be vented to the outer air to prevent the accumulation of explosive vapors.

g. DRYING CABINET

1. Drying cabinets, except for those with wooden interiors which are already in use, should be constructed of noncombustible material. Existing cabinets with wooden interiors should be lined with insulating material not less than $\frac{1}{4}$ inch thick.
2. Racks used in drying cabinets should be noncombustible.
3. Cabinets should be ventilated to the outer air to prevent the accumulation of explosive vapors. Where heat is used for drying, flammable vapors may be given off even with a high flash solvent.

h. FIRE FIGHTING EQUIPMENT. See 24203, paragraph 6a.

5. Cleaning Operation

a. TYPES OF CLEANERS. The following information should be used as a basis for determining the safest cleaner to use under certain specified conditions. For further details see the National Fire Protection Association Pamphlet No. 32.

1. Naphtha has a volatility similar to that of gasoline. Use instead Stoddard Solvents (especially refined petroleum products) or other solvents with a flash point over 100°F to reduce hazards of gasoline and naphtha.
2. Use a solvent of the rating which is prescribed for the dry cleaning system being used.

b. GENERAL PRECAUTIONS

1. All clothes shall be thoroughly searched before cleaning and all foreign materials, especially matches and metallic substances, removed.
2. No drying operation before washing shall be permitted unless articles so dried are properly humidified before removal to washing machines.
3. Check all liquids used. Even in plants using nonflammable solvents spotting operations are often done with flammable solvents. In case of doubt about any cleaning fluids, check the flash point.
4. Volatile flammable liquids, except those contained in a still, purifier, supply tank for clarifier, or an underwriter's approved container, shall not be placed above ground level during cleaning operations.
5. Volatile flammable liquids shall not be settled in open or unprotected vessels or tanks.
6. Flammable liquids or solvents are not to be used for cleaning floors.
7. Cleaning solution that is spilled should be mopped up immediately.
8. Dry cleaning by immersion and agitation in closed machines shall be carried on only in machines that have been approved for this type of cleaning.
9. Dry cleaning by immersion and agitation in open vessels is prohibited. When articles cannot be washed in the customary machines, they may be cleaned on scouring or brushing tables, or in approved scrubbing tubs. In such instances, not more than 3 gallons of solvent are to be used at one time.

c. SPOTTING

1. Spotting is a special hazard because of the low flash point of most liquids sold for spotting. Too much friction in rubbing spots can cause ignition of the material.
2. Avoid inhaling vapors because of getting too close to material during spotting operation.

3. Not more than one quart of flammable solvent should be used at one time during spotting operations. The solvent shall be stored in and applied from an approved safety can.

d. **DISPOSAL OF LIQUIDS.** Cleaning fluids are ordinarily distilled for reuse or, when necessary, are disposed of completely. The following rules for distillation and disposal should be followed. For further details see article 14313 or NFPA Dry Cleaning Pamphlet No. 32 or current edition of National Fire Code, Vol. 1.

1. Flammable liquids shall not be discharged into drains or sewers. When disposal presents an accident, health, or fire hazard, the safety engineer, fire chief, district fire protection engineer, or medical officer shall be consulted for proper disposal method.
2. Stills are not to be used for storage purposes.
3. Distilling apparatus should be drained of solvents at the close of business each day.
4. Stills, condensers, and treating tanks shall be of substantial construction, mounted on substantial fire resistive foundation or framework, and shall be of a type which will not expose the liquid during any part of the process or reclamation. Steam or hot water *only* shall be used to secure the necessary temperature. Stills and condensers shall be liquid and gas tight.
5. Each still shall be equipped with a vacuum and pressure relief valve arranged to discharge outside the building. Relief valve shall be not less than 1½ inches and set not over 5 pounds. When a shut-off valve is installed between still and condenser the relief valve shall be located on the still side of shut-off valve. A check valve shall be installed in the steam line between the boiler and the still.
6. Each still shall be provided with an automatic heat actuated emergency drain connection of ample capacity to discharge entire contents to underground storage tanks within a period of five minutes.

7. Where not practical nor desirable to distill cleaning fluids for reuse, the storage, handling, or disposal of same shall be in accordance with the standard Navy Department practice for handling or disposing of contaminated volatile liquids.

6. **Fire Protection.** Since fire hazards in a dry cleaning shop are particularly great, constant awareness of all precautions is essential.

a. **EQUIPMENT.** The following equipment shall be used to insure the highest possible degree of safety:

1. An asbestos blanket not less than 7 x 7 feet and a boat hook with a handle at least 6 feet long shall be provided for each dry cleaning room and shall be kept on a convenient rack at the principal entrance.
2. Approved extinguishing devices of a type suitable for use on oil fires (class B) shall be provided for every room or area where flammable liquids are stored or used. In no case shall there be less than one extinguisher at each entrance of every room or area where liquids are stored or used.

b. **GENERAL PRECAUTIONS**

1. Fire fighting equipment shall be inspected regularly to insure its immediate usability in case of emergency.
2. Smoking is strictly prohibited in dry cleaning rooms. "No Smoking" signs shall be conspicuously posted.
3. Particular care must be taken to remove matches and lighters from pockets of clothing which is to be dry cleaned.
7. **Fire Fighting.** In case of fire, call the Fire Department immediately. Employees should then proceed to operate *only* as an auxiliary fire brigade by assisting the regular fire fighters.

a. **VENTILATING SYSTEMS.** Shut down the ventilating system immediately in case of fire. Interlocks should be provided to accomplish this from automatic extinguishing systems.

b. **USE OF AUTOMATIC SYSTEMS.** Use the automatic extinguishing system. *Do not stay in the room for purposes of manual fire fighting unless the fire is confined to a small portion of the room.* Flammable liquids cause too much heat and smoke to allow manual fire fighting.

C. PRINCIPAL METHODS OF EXTINGUISHING

1. Automatic covers will smother fire when they are closed automatically by operation of a fusible link. They are suitable for any size tank but not where objects being dipped, or conveyors, may prevent tight closing.
2. Carbon dioxide extinguishers are effective for gasoline fires in small tanks. They are also satisfactory for use on alcohol fires.
3. Carbon dioxide automatic flooding systems are acceptable for extinguishing fires in any flammable liquid.
4. A dry chemical extinguisher is effective for class B and class C fires and for alcohol fires.
5. A foam extinguisher is effective for class B fires. Special types of foam are needed for alcohol fires.
6. Automatic foam systems provide excellent protection against petroleum fires if properly designed. Special alcohol-resistant type foam must be used for alcohol fires.
7. Water spray (fog) extinguishes fires in fuel oil, linseed oil, lubricating oil and other heavy liquids. Water spray does not readily extinguish fires from kerosene, gasoline, and other light liquids but does absorb heat and help prevent spread of the fire to other combustibles.
8. Automatic sprinklers are not effective extinguishers on petroleum fires but do absorb heat and keep the surroundings cool until the liquid fire has been extinguished by other means.
9. Solid hose streams are good for keeping tanks cool or for washing burning spills on the floor away from danger points. A hose stream serves only to spread fire when directed into open tanks of gasoline and similar liquids.

d. AFTER-FIRE CARE. Cool all embers and hot metal surfaces to erase the danger of reignition.

24204 BARBER SHOP**1. General Rules**

1. Keep the barber shop clean.

2. Observe personal cleanliness. Barbers shall be examined by the medical officer at regular intervals.

3. Do not perform barber services on persons showing symptoms of diseases of the scalp or skin unless the medical officer has directed in writing that these services be performed.

4. Do not remove ingrown hairs or blackheads for customers.

2. Use and Care of Equipment

1. Use extreme caution in handling such potentially dangerous equipment as razors and scissors. Avoid jostling.

2. Sterilize such equipment as razors, scissors, clippers, combs, and brushes before using.

3. In shops doing a large amount of business alternate clippers should be used so that the clippers will not become overheated.

4. Keep sterilizing cabinets in the proper sterilizing condition in accordance with instructions from the medical officer.

24205 BEAUTY SHOP**1. General Care**

1. Keep the beauty shop clean.
2. Observe personal cleanliness. Beauty shop operators shall be examined by the medical officer at regular intervals.

3. Do not perform beauty shop services on persons showing symptoms of diseases of the scalp or skin unless the medical officer has directed in writing that these services be performed.

4. Do not remove ingrown hairs or blackheads for customers.

2. Equipment**a. HAND-OPERATED TOOLS**

1. Use extreme caution in handling such potentially dangerous equipment as razors and scissors. Do not carry scissors, razors, and other such equipment in your pockets. Avoid jostling.

2. Sterilize equipment such as razors, scissors, clippers, combs, and brushes before using.

3. Keep sterilizing cabinets in the proper sterilizing condition in accordance with instructions from the medical officer.
4. Always follow strictly the manufacturer's instructions for use of equipment when giving a machineless wave.
5. When giving machineless waves use new aluminum foil pads and absorbents for each customer.

b. PERMANENT WAVE MACHINES

1. Do not leave the customer during the time the machine is being heated. The thermostat may fail to work automatically and cause severe burns.
2. Check time-clock to determine whether it is working properly.
3. As a fire prevention measure, do not use flammable covers on permanent wave units or dryers when these machines are not in use.
4. Supplies used for a permanent wave machine must be those which are specifically designed for that machine.

24206 WATCH REPAIR SHOP

The following precautions to insure personal protection are to be observed in the watch repair shop:

1. Exercise care to prevent cutting hands on broken lenses and crystals.
2. Wear gloves and goggles when using a crystal grinding machine or lathe.

24207 LAUNDRY

1. Care of Laundry Room

1. Store acids, bleaches, and other strong solutions in cool, dry areas on lower shelves only.
2. Materials or bundles shall not be piled on shelves in such a way that they protrude into passageways or are likely to fall.
3. Keep the floor drains unclogged.
4. Sweep suds and water down the drains frequently.
5. Sleeping in the laundry room is prohibited.

2. Personal Protection

1. Wear proper personal protective equipment such as goggles, rubber gloves, and

rubber aprons when handling or using acids, bleaches, solvents, boiler compounds, and caustic solutions.

2. Employees shall not wear neckties or loose-fitting clothing, and female employees shall wear a protective covering over their hair.

3. Wear goggles when using an air hose to blow dirt from pockets and cuffs.

4. Do not attempt to pour acid from a carboy without use of a suitable carboy dispenser or rocker.

5. If caustic solutions are spilled on the body, thoroughly wash the affected parts in accordance with posted instructions. Report to the dispensary for examination and for further treatment if it is required.

3. Preparing Clothes for the Laundry

1. When using a truck for heavy bundles of clothing the load should be so placed that the pusher has a clear view ahead.
2. Dump laundry out of bags. Do not reach into the bags to pull the laundry out.
3. Be sure that the pockets of clothing to be laundered are empty.
4. Keep safety pins closed.

4. General Safety Rules

1. Nails projecting from soap or washing powder boxes or barrels shall be removed promptly when the package is first opened.
2. All crating and packing materials shall be disposed of at the time they are opened.
3. Storage bins, shelving, and timbers shall be watched for ragged edges and splinters, and such defects shall be corrected immediately.
4. Barrels, boxes, and containers shall be properly marked as to contents and shall be stored so that the label can be seen without moving the container.
5. All machines and safety devices shall be checked daily for defects, and any necessary repairs shall be made promptly.

5. Equipment

a. WASHER

1. Driving mechanisms of washers should be fully encased by metal guards.

2. Be sure the power is off before loading or unloading the machine.
 3. Avoid straining muscles when unloading the washer. Do not attempt to unload too much at one time.
 4. Machines should be provided with approved means for holding the shell doors open.
 5. Safety interlocks are to be provided to prevent the cylinder from operating when the machine is being loaded or unloaded, except when using the "inching" device.
 6. The brakes should be capable of stopping and holding the cylinder against rotation when the current is shut off.
 7. Inspect cylinder doors daily to determine that they are in proper working condition.
 8. Cylinder doors should be fitted and wedged in such a manner as to prevent movement when they are locked.
 9. Swing the apron out of the way before closing cylinder doors.
 10. Latch the cylinder doors before starting the machine. The latch handles should be placed securely in their wells.
 11. Do not turn on the steam until the doors are closed and the safety switch is on. Never assume that the safety switch is on; be sure.
 12. Do not open the shell doors while the machine is in operation.
 13. Do not put bleach in the water when the steam is on.
 14. Do not allow the temperature of the wash water to rise above 160°F.
 15. The tension of the belts on the wood washers should be tested frequently to see that the belts are not slipping. Test only when machine is inoperative.
 16. Never shift belts by hand.
 17. Try to prevent rust remover from coming into contact with your skin. Thoroughly rinse fabrics which have been treated with rust remover.
 18. Splash guards should be installed on the floor drains to prevent the occurrence of slipping hazards.
 19. The washing machine should be provided with a drain to carry away suds and water without wetting the floor.
- b. EXTRACTOR**
1. Check safety devices before operating the machine. If the mentioned safety devices are inoperative *secure the extractor and do not use until it is repaired.*
 2. Never operate the extractor with the cover open. This has often resulted in the death of the operator.
 3. Do not exceed the rated capacity when loading the machine. Overloading is injurious to the machine as well as an accident hazard to personnel.
 4. Distribute the load evenly. If the machine vibrates excessively, or the basket wobbles, stop the machine and redistribute the load.
 5. Never overload the machine.
 6. Keep away from the extractor while it is in motion, except when starting or stopping the machine.
 7. Do not use the foot brake to stop the tub while the tub is rotating at high speed.
 8. Adhere strictly to the manufacturer's precautions as to the frequency of starting and stopping the machine.
 9. Do not leave the brake on when the extractor is empty.
 10. Inspect hoists and monorail equipment daily to determine whether they are in proper condition.
 11. Never walk or stand beneath a raised extractor basket.
 12. The extractor should be provided with a drain to carry away suds and water without wetting the floor.
- c. DRYING TUMBLER**
1. Be sure the power is off while loading or unloading the machine.
 2. Never overload the machine.
 3. The tumbler should be equipped with an approved means of holding the doors or covers on cylinders and outer shell open while loading or unloading the machine.
 4. Inspect daily the balancing mechanisms and safety latches to insure that the door will be secure when open.

5. The interlocks on the doors, which prevent the cylinder and fan from rotating when the doors are open, should be inspected daily to determine that they are in proper working condition.
6. High speed tumblers should be equipped with a dial or other approved means of indicating the position of the cylinder doors in relation to the case door.
7. Be sure that the cylinder doors are latched and that the latch handles are secured in their wells before the machine is started.
8. Never open the door while the tumbler is in motion.
9. Clean lint from tumbler screens after every four hours of operation. Dispose of it immediately, by placing it in a container and covering it with water.
10. Sufficient moisture should be maintained to prevent fires. Clothes should be removed from tumbler when dried to a weight not exceeding 30% above dry weight of clothes.
11. Make sure that fans, feed belts, and cylinder drive mechanisms are enclosed in metal guards.

d. MANGLE

1. Keep hands at least 6 inches from the rollers when operating the machine.
2. Never overlap pieces being run through the machine.
3. When an article has started to pass through the rollers, never attempt to withdraw it.
4. If an article becomes bound or fouled shut off the current and loosen the rollers. Do not attempt to extract the article in any other manner.
5. The machine shall be equipped with a safety guard across the front of the feed rollers which will quickly stop the rollers when the guard is struck with the hand.

6. This guard should be inspected daily to determine that it is functioning properly.
7. Do not operate the mangle when this safety guard is not functioning properly.

e. PRESS

1. Nobody but the operator should be permitted to stand close to the press when it is in use.
2. Keep hands clear of the buck when the head is coming down.
3. Air-operated presses are equipped with two push-button operating valves for safety. The arrangement is such that both hands must be used to close the press, thereby making it impossible for a hand of the operator to be caught in the press. *In no case shall either of these valves be by passed or left permanently open.*
4. Release the head when the press is not in use.
5. When releasing the head, be sure nobody is standing at either end of the machine.
6. Each press, excluding the hand or foot operated types, shall be equipped with an approved safety device which will prevent the operator's fingers being caught in the machine.

f. HAND IRON

1. Each iron should be equipped with a pilot light to indicate when the current is on.
2. Each iron shall be turned off and disconnected immediately after use and placed until cool where there is no danger of burning to articles or to personnel.

g. BUNDLE TYING MACHINE. The machine should be equipped with an appropriate guard to prevent the operator's hands coming into contact with the moving arm.

h. MARKING MACHINE. An electric marking machine should be equipped with an appropriate guard to prevent the operator's fingers coming into contact with the marking dies.

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United States Navy
SAFETY PRECAUTIONS

Chapter 25
REFRIGERATION

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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Chapter 25
REFRIGERATION

Subsection A
PERSONNEL

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25101 QUALIFIED WORKERS

Only experienced workmen who are familiar with the nature of refrigerants and the precautions that must be taken with them shall be assigned to such operations as the storage, transportation, and transfer of refrigerants from larger to smaller cylinders or to other installations, or to refrigeration service and maintenance operations.

25102 PERSONNEL PROTECTION

1. Protection From Gases and Liquids

a. USE OF GAS MASKS. Because a toxic refrigerant, when inhaled even in small quantities, is injurious to the lungs, approved gas masks or self-contained oxygen locating apparatus shall always be worn by personnel repairing leaks or purging. These gas masks should be kept in a suitable cabinet immediately outside the machinery room or at some other readily accessible location. The canisters or cartridges of masks shall be renewed immediately after having been used or after the seals have been broken; if unused the canisters (except chemical warfare gas masks and oxygen locating apparatus canisters) must be renewed at least once every 2 years.

b. USE OF CLOTH OR SPONGE. In case of emergencies where gas masks are not available, rescue personnel should cover mouth and nostrils with wet cloth or sponge in the presence of ammonia or sulfur dioxide fumes. Those refrigerants are soluble in water. Personnel

should keep low to the deck or floor in the presence of ammonia because it is lighter than air. They should avoid low levels and possible gas pockets in the presence of sulfur dioxide, carbon dioxide, freon, and methyl chloride, because those gases are denser or heavier than air.

c. USE OF GOGGLES. The eyes must be protected when working in an atmosphere containing toxic refrigerant. Goggles (rubber frame Navy spec., No. 31-G-28) shall be worn whenever loosening a connection in which *any* refrigerant liquid might be present. The goggles should eliminate the possibility of liquid refrigerant coming in contact with the eyes and causing possible injury due to freezing moisture in the eyes.

2. Emergency Treatment for Injuries

a. EXPOSURE TO FUMES. If a person has been exposed to toxic fumes, take him into the fresh air and call the medical officer promptly. If the patient is unconscious, keep up artificial respiration. When eyes are affected, hold the lids open and pour water or a 2 percent boric acid solution over the eyeballs and lids, washing thoroughly for 5 minutes. Then allow two drops of liquid petrolatum to fall on the eyeball. When the nose and throat are affected, have the patient snuff boric acid solution up the nose and rinse the mouth thoroughly. Encourage the patient to drink large amounts of water.

b. INJURY TO EYES. If liquid refrigerant accidentally comes in contact with the eyes, the person suffering the injury should be taken at once

to the medical officer. Rubbing of the eyes should be avoided, and the following first-aid treatment should be given immediately:

1. Drops of sterile mineral oil should be introduced into the eyes as an irrigant.
2. If irritation continues at all, the eyes should be washed with either a weak boric acid solution, or with a sterile salt solution not to exceed 2 percent sodium chloride.

c. **INJURY TO SKIN.** If liquid refrigerant comes in contact with the skin, the injury should be treated the same as though the skin had been frost bitten or frozen.

(1) *First Aid Materials.* Keep the following

materials on hand in clean, easily accessible containers:

- One gallon bottle 2 percent boric acid solution.
- One quart bottle saturated aqueous solution of picric acid.
- One pound sealed package absorbent cotton.
- One ounce liquid petrolatum and medicine dropper.

(2) *Method of Treatment.* The refrigerant saturated clothing should be stripped from the body. Wash the skin with water; then paint burned surfaces with a saturated solution of picric acid. (Use boric acid near the eyes.) Do not cover burns with clothing or dressings.

Subsection B

EQUIPMENT AND PLANT

25201 REFRIGERANTS

1. **Types of Refrigerants.** Refrigerants are likely to be toxic, flammable and/or explosive. Freon refrigerants, while not toxic, will decompose into toxic products if the vapor should come into direct contact with an open flame of high temperature (about 1,000° F.). The nameplate of the compressor unit should be checked to determine the type of refrigerant for which the system is designed.

a. **TOXIC REFRIGERANTS.** The following refrigerants are toxic in that they can cause death or serious injury, depending upon concentration and duration of exposure or inhalation:

Sulfur dioxide	Ethyl chloride
Ammonia	Methylene chloride
Methyl formate	Dichloroethylene
Methyl chloride	

All refrigerants, whether toxic or nontoxic, are hazardous to the extent that they can cause suffocation by oxygen deficiency.

b. **FLAMMABLE AND/OR EXPLOSIVE REFRIGERANTS.** The following refrigerants are flammable and/or explosive, depending upon the concentration:

Methane	Isobutane
Ethylene	Butane
Ethane	Ethyl chloride
Propane	Methyl formate
Ammonia	Dichloroethylene
Methyl chloride	

(1) *Causes of Explosions.* Explosions that have occurred in refrigerating rooms have been caused by the presence of open flames, exposed electrical conductors and switchboard contacts, introduction of improper gases (particularly oxygen), and the presence of air in the refrigeration system. Oil mist flowing through a nozzle can generate a static spark sufficient to cause an explosion. To guard against such explosions all electrical equipment in refrigeration systems should be adequately grounded against the creation of static sparks.

(2) *Ammonia.* When dissociated in the presence of oil, ammonia is susceptible to violent explosion. Therefore great care must be exercised in the handling and use of this refrigerant, and the manufacturer's instructions for charging and purging the ammonia refrigerating system must be followed closely.

25202 DETECTION OF REFRIGERANT LEAKS

Leaking refrigerant under pressure can be located by various methods depending upon the refrigerant being used and the means at hand:

1. **Use of Soapsuds.** Soapsuds can be used on any refrigerant connection but will not always reveal small leakages.

a. **PREPARING THE SUDS.** To prepare soapsuds for testing, use a soap-and-water solution which will lather freely, and prepare a lather. A few

drops of glycerine added to the solution will cause the lather to remain wet longer.

b. APPLYING THE SUDS. When applying the soapsuds, paint the soap lather on the joint all the way around. Then examine the joint thoroughly for bubbles. A shaving brush is helpful in applying the lather. When the joint is so located that part of it is not visible use may be made of a small mirror. It will sometimes take a full minute or more for bubbles to appear at a small leak. Questionable spots should be covered again with lather and reexamined.

2. Use of the Halide Torch. Halogenated refrigerants such as methyl chloride, ethyl chloride, the freons, and methylene chloride are best detected by use of a "halide torch"; however, precautions must be exercised to provide adequate ventilation to prevent ignition of methyl chloride and ethyl chloride, since these refrigerants are flammable. The acetylene-burning halide torch has been found to be generally satisfactory for freon leak detection. However, if a pump pressure alcohol burning type halide torch is employed, care must be taken to be sure that the air pumped into the tank is pure and uncontaminated. The torch should always be charged and pumped in a place remote from the refrigerating system in order to avoid a false indication when it is used for detecting refrigerant leaks.

a. PROCEDURE TO BE FOLLOWED. The halide torch is used by drawing atmosphere suspected of containing refrigerant vapor through an exploring hose into the torch burner by injector action. The air sample passes over a copper reactor plate which is heated to incandescence by the burner flame, and if there is even a trace of refrigerant present the torch flame will turn from its normal blue or neutral color to a characteristic green color as it comes in contact with the reactor plate. The shade of green will depend upon the relative amount of refrigerant present, being pale for small concentrations and dark for heavier concentrations. Excessive quantities of refrigerant will color the flame a vivid purple and may even extinguish it by crowding out the supply of oxygen in the air.

b. RESTRICTION IN USE. A halide torch will detect very small leaks, but the torch is so sensitive that if there are large leaks in the system

the atmosphere around the apparatus will become so contaminated with refrigerant as to make it impossible to locate the exact source of the leak with the torch. This condition is likely to prevail when the equipment is located in a small or poorly ventilated room or compartment. Under such conditions the halide leak detector is of little value to discover the exact location of the leak, and soapsuds should be used.

3. Detecting Sulfur Dioxide Leakage. The "smoke" method may be used with sulfur dioxide refrigerant for locating small leaks. Suspected joints should be explored with a swab dipped in a 25 percent solution of aqueous ammonia. When contacted by leaking sulfur dioxide the vapor will cause a "smoking" at the junction of the gases.

4. Detecting Ammonia Leaks. Small ammonia leaks may be located by passing a piece of porous paper soaked in a phenolphthalein solution or Ressler solution near the suspected leak. Appearance of a red spot in the paper indicates the presence of a leak.

25203 CARE OF REFRIGERANT CYLINDERS

1. Handling

1. Refrigerant cylinders shall never be dropped or permitted to strike each other violently.
2. A lifting magnet or a sling (rope or chain) should not be used when handling cylinders. A crane may be used to transport them when a safe cradle or platform is provided to hold the cylinders securely.

2. Use

1. Whenever refrigerant is discharged from a cylinder the operator shall immediately weigh the cylinder and record the weight of refrigerant remaining in the cylinder.
2. No one shall ever attempt to mix gases in a cylinder.
3. When a cylinder is emptied the valve should be immediately closed to prevent the entrance of air, moisture, or dirt.
4. Cylinders should never be placed in a bath of hot water for the purpose of accelerating the withdrawal of the gas, as this may cause the fusible plugs to melt out.

5. Cylinders shall never be used for rollers, supports, or for any purpose other than to carry refrigerant.

3. Care of Parts

1. The caps provided for valve protection shall be kept on the cylinders except when the cylinders are in use.
2. The safety devices in valves or cylinders should not be tampered with or repaired.
3. Care shall be exercised to make sure that the threads on regulators or other connections are the same as those on the cylinder valve outlets. Connections that do not fit should not be forced.
4. Regulators and pressure gages provided for use with a particular refrigerant must not be used on cylinders containing a different type of refrigerant.

4. Storage

a. **AUTHORIZED POSITIONS FOR STORAGE.** All cylinders carrying refrigerants shall be stored upright in a cool dry place unless the cylinder base is so small as to permit toppling. Such cylinders shall be stored on their sides. However, all cylinders stored aboard ship shall be secured in an upright position.

b. STORAGE IN THE OPEN

1. Cylinders may be stored in the open if protected against extremes of weather but should not be exposed to continuous dampness, salt water, or salt spray, which would cause corrosion of the caps.
2. Cylinders stored in the open during the winter should be protected against an accumulation of ice or snow.
3. Cylinders stored in the open during the summer should be screened against continuous direct rays of sunlight.

c. **MAXIMUM TEMPERATURE ALLOWED.** No part of any cylinder containing compressed gas should ever be subjected to a temperature above 125° F. A direct flame or jet of steam should never be permitted to come in contact with any part of a compressed-gas cylinder.

d. **PROTECTION FROM FLAMMABLE MATERIALS.** Cylinders shall not be stored near highly flammable substances such as oil, gasoline, or waste.

e. STORAGE LOCATIONS

1. Full and empty cylinders should be stored

apart to avoid confusion in handling them.

2. Full cylinders shall not be stored near elevators or gangways or in locations where heavy moving objects may strike or fall on them.
3. Cylinders shall be protected from any object that could possibly produce a cut or other abrasion in the surface of the metal.

5. **Shipping.** The Interstate Commerce Commission (Bureau of Explosives) regulations as to the type, size, strength, test pressures, and the design marking of refrigerant containers must be complied with when shipping refrigerants.

25204 SAFETY IN REFRIGERATION PLANTS

1. Protection to Workmen

1. When opening valves connected to a gage glass always protect your eyes and face by wearing goggles or large lens spectacles. If refrigerant is released under pressure it can cause painful and dangerous injuries; blindness can result from contact.
2. No one shall stand in front of the cylinder head of a refrigeration system in line with the piston stroke. If liquid should be drawn into the cylinder the head might be blown off during a compression stroke, and broken cylinder heads have been known to fly into the air with considerable force.
3. The moving parts of all refrigeration systems such as belts, gears, couplings and flywheels, should be guarded so as to prevent possible injury to operators and maintenance personnel.

2. Operating Compressors

1. Be sure that water is flowing through the condensers when the compressor is in operation.
2. Be sure that the brine is circulating through the coolers on which the compressor is working.
3. Do not start the compressor until after you have assured yourself that the discharge valve is open.

4. Watch carefully the condenser pressure when starting; this will give you warning of any improper conditions.
5. Extreme care must always be exercised by refrigeration machine operators and mechanics to make sure that only the appropriate gas for the particular type of machine is introduced into the system.
6. When shutting down a compressor for overhaul or servicing, line fuses must be removed to prevent accidental starting which would jeopardize personnel working on or near the compressor.
3. **Proper Use of Refrigerant Cylinders**
 - a. **CONNECTING TO SYSTEM.** Refrigerant cylinders shall never be connected to the refrigerating system except when the system is being charged or drained.
 - b. **FILLING CYLINDERS.** If it becomes necessary to withdraw refrigerant from a system into cylinders, great care shall be taken to avoid overcharging such cylinders. The cylinders should be weighed before and after filling and checked against allowable weights stamped on them. If they are accidentally overfilled the excess should be allowed to escape immediately into a flowing water drain.
 4. **Inspection of Coils.** The brine coils or expansion coil supports of refrigeration systems should be inspected at every defrosting period, or at least once a year, to see that they have not become corroded to an unsafe condition. Failure of these coil or pipe supports because of corrosion can damage the refrigeration system and seriously injure personnel.
 5. **Identifying Pipe Lines and Valves.** For shore installations, refrigeration piping should be

painted in accordance with "Color Code for Compressed Gas Cylinders and Piping," MIL Standard No. 101 effective 1 January 1951.

25205 GROUNDED WALK-IN REFRIGERATORS (ADVANCED BASE TYPE)

1. **Grounding Metal Sheathing.** Persons using or doing repair work upon any of the Advanced Base Type Walk-In Refrigerators, Navy Standard Stock Nos. Y66-R-345-600 or Y66-R-345-800 (formerly Bureau of Yards and Docks Stock List Nos. 2Q64-11 or 2Q64-13), shall make sure that the exposed metal sheathing of all panels of the refrigerator walls, ceiling, floor, or door, both on the inside and outside of the box, has been permanently grounded. BuDocks Circular Letter No. 5-48 contains instructions for grounding such refrigerators. Also, personnel using or starting to work upon any of the other types of Navy Walk-In Refrigerators shall make sure that the corresponding parts of those refrigerators have been grounded.

2. **Principle of Grounding.** Electrical equipment is grounded by being connected to the earth or to some extended conductive body which serves the same purpose. The frames of motors, electrical conduits, switchboards, etc., and certain parts of refrigerators are grounded as a safety measure to prevent their becoming electrically charged. Anyone touching an energized part of the grounded equipment will be saved from serious injury because the current will not be likely to flow through him to the ground and produce a shock, burn, or possible fatality.

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**UNITED STATES NAVY SAFETY
PRECAUTIONS (OPNAV 34P1)**

**CHANGE NO. 5
13 MAY 1963**

OIR, SecNav

CHANGE NO. 5

Attached are pages to OPNAV 34P1, U.S. NAVY SAFETY PRECAUTIONS, which should be substituted and inserted as indicated in the table on the attached sheets.

REASONS FOR CHANGES

Article 02341,1—Licensing requirements for forklift truck operators added.

Article 02342,2—Provision for forklift extensions included.

Article 03217,1.c—To exclude certain Marine units from color requirement.

Article 03503,4—To prohibit use of flammable or toxic fluids in aircraft.

Article 04102,2.c—Push poles no longer used.

Article 04201—Motor vehicle definitions expanded to include all types used today.

Article 04213,4.b.(1)—Publication reference changed.

Article 04213,4.b.(3)—ICC requirements added.

Article 04213,4.c.(1)—Safety chain requirement changed.

Article 04215,2—Provisions for courier and relief driver included.

Article 04215,3.a—Details of inspection procedure added.

Article 04215,3.b—Corrected to conform with ICC Regulations.

Article 04215,3.c—Specific type of fire extinguishers provided.

Article 04215,3.d—Provision for off-station shipments included.

Article 04215,4.a.(1)—Fire, water, and weather resistant container permitted in lieu of tarpaulin.

Article 04215,5.c—Speed limit made more realistic.

Article 04215,5.d—ICC requirements added.

Article 05103—Nylon rope safety precautions added.

Article 05327—Safety precautions for SCUBA diving added.

Article 07111,5.g—Ladder climbing safety device added.

Article 09103,1—Provisions for testing and licensing crane operators added.

Article 11203,1—Prohibition of prying cylinders made consistent with 17422,4.

Article 17131—Criteria for toxicity of petroleum fuel vapors brought up to date.

Article 17135—Reference to NAVDOCKS P-342 and BUSHIPS Technical Manual added.

Article 18304,4.b.6—Table of radar minimum safe distances revised.

Article 20101,7—Prohibition of the manufacture of unapproved explosive devices added.

Article 20103,25.c.4—Criteria for safe waiting period under gun hang-fire conditions revised.

Article 25204,6.a—Refrigerator distress alarms deleted.

Supplement 1, Page S-2—Hazard label design reference changed.

By direction of Secretary of the Navy:



M. J. LAWRENCE,

*Rear Admiral, USN,
Chief of Industrial Relations*

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(OPNAV 34P1)

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4. Storage of Flammables. Flammable materials, such as paints, oils, grease, gases, and gasoline, are best protected when placed in a special nonflammable building with extra fire-fighting equipment and additional firewalls. Because of lack of such space, however, it may be necessary to store flammables in a general

storage warehouse. In this case, precautions will be taken to:

1. use end bays whenever possible;
2. remove and destroy leaky containers;
3. insure proper ventilation for materials which give off flammable or toxic vapors;
4. use only spark-enclosed or sparkproof fork trucks.

Subsection C

MATERIALS HANDLING VEHICLES

02341 GENERAL REQUIREMENTS

1. Licensed Operators. Forklift trucks, straddle trucks, and industrial tractors shall be operated only by duly authorized operators who have been qualified and licensed in accordance with Bureau of Supplies and Accounts Publication 284, *Storage and Materials Handling Handbook*.

2. Passengers. Industrial vehicular equipment shall never be used for personal transportation. No workman other than the driver shall ride on any industrial materials handling vehicle unless a permanent seat is provided.

3. Loads. The operator is responsible for all cargo being moved by his machine. He shall inspect and secure all questionable loads and shall refuse to transport unsafe or unlawful loads.

4. Steering Wheel Projections. No fork truck or other materials handling equipment shall be equipped with a steering knob except those especially designed for one-hand steering and provided with a steering knob by the manufacturer. Extensions to gear-shifting levers will be permitted only when approval has been granted by the Bureau of Supplies and Accounts via the appropriate management authority.

5. Clear Vision. All materials handling equipment will be free of cabs, windshields, enclosures, canopies, and any other device which may constitute a safety hazard by obstruction of vision. Side curtains may be placed on straddle trucks provided they do not extend above the top of the cowl and are made of transparent material with only sufficient

opaque material to permit fastening. When equipment has an overhead safety guard in accordance with instructions herein, it will be free of any material that may obstruct vision in any direction.

6. Adjusting Mechanism. Operators shall not attempt to fix or adjust any mechanical part of any materials handling vehicle unless authorized to do so by their supervisor.

7. Gasoline-Powered Vehicles. Gasoline-powered and gas-electric-powered materials handling equipment will be equipped with mufflers, gas fill caps, and metal sediment bowls. They shall have flame arresters when operating in flammable liquid storage areas where it is not feasible to use electric-powered spark-proof or explosion-proof equipment. Fuel shall be dispensed from Underwriters Laboratory approved containers. All fueling operations shall be done out-of-doors.

8. Vehicle Unattended. Operators shall never leave vehicle unattended while the motor is running.

9. Speed Limit and Care at Exits. For trucks and tractor-trailer trains shall not exceed the speed limit of 7 miles per hour. They shall slow down at all cross aisles and other passageways. When entering or leaving buildings, warehouses, etc., the operator shall come to a complete stop at entrance, sound horn, and proceed only when the way is clear. These vehicles shall be operated in a safe and prudent manner at all times.

02342 FORK TRUCKS

1. Overhead Safety Guards. Fork-lift trucks of all types will be equipped with an overhead

safety guard fabricated from steel. Exceptions will be permitted only when the overhead safety guard would either increase the overall height of the fork truck or prevent the operator from having freedom of movement. Overhead guards will be capable of withstanding, without evidence of damage, a minimum drop of 5 feet of a wood box or container of 1 cubic foot of volume, weighing 100 pounds. Open spaces between steel bars or tubes will not exceed 6 inches.

2. Load Capacity. The load capacity, and gross weight of each fork truck, shall be stenciled on the machine in plain view of the operator. This capacity shall never be exceeded. Counterweighting of machine to increase lifting capacity is prohibited. Capacity shall be rated at 24 inches from heel of forks. The load capacity of fork extensions shall be computed in accordance with Bureau of Supplies and Accounts Publication *NAVSANDA Pub 284*.

3. Standing Under Loads. No personnel shall ever stand under loads being hoisted or lowered by fork trucks.

4. Facing Forward. Operators shall always face in the direction of travel. All loads shall be carried in such a manner that operator's vision is unobstructed in direction of travel.

5. Ramps and Grades. Fork trucks transporting cargo up ramps or other grades shall be operated with the load up grade; carrying cargo down grade shall be done by backing down grade with the load up grade.

6. Channels Tipped. All loads being transported shall be carried with channels tipped back.

7. Hoisting Personnel. Fork trucks shall be used to hoist personnel only under the following conditions:

1. Supervisor shall authorize all raising and lowering of personnel by fork trucks.
2. Special "personnel pallets" with guard rails on four sides shall be used.
3. During actual raising and lowering operation, all personnel shall face away from mast and keep hands clear of hoisting mechanism.
4. Personnel shall never be transported when the forks of the fork lift truck are raised more than 18 inches above the floor level.

5. Only skilled personnel shall be asked to perform tasks requiring elevation by fork trucks.

8. Lifting Vehicles. Slings or lifting pads shall never be attached to the overhead guards for the purpose of lifting the vehicle.

9. Nonoperating Position. When not in operation, the forks shall be lowered and rested flat on the floor.

10. Bumping Stacks. Stacks shall never be bumped or pushed by fork trucks in an attempt to straighten stacks.

11. Spacing. In all operations involving more than one fork truck, vehicles shall always remain 20 feet apart unless two vehicles are transporting the same object.

02343 STRADDLE TRUCKS (GANTRY TRUCKS)

1. Inspection. Before commencing daily operations, each straddle truck driver shall thoroughly check vehicle in accordance with standard procedures. All approved guards and safety devices shall be in proper repair and in operation at all times.

2. Blocking up Cargo. All cargo carried by these vehicles shall be blocked up sufficiently to prevent any part of cargo coming in contact with surface over which cargo is being transported.

3. Marking Cargo. Cargo extending beyond lines of straddle truck shall be clearly marked with red danger flags during daylight hours; at night red lights shall be used.

4. Sounding Horn. Straddle trucks operating in the vicinity of personnel shall sound noisemaking device.

5. Public Highway Operation. Straddle trucks operating on public streets or highways shall be equipped with all safety devices required by State law.

02344 TRACTOR-TRAILER TRAINS (JITNEYS AND TRAILERS)

1. Traffic Regulations. Tractor operators shall obey all traffic regulations at all times.

2. Trailer Connections. Trailers shall be firmly hitched one to the other and to the tractor before beginning operations. These hitches shall be inspected at least four times daily.

3. Maximum Number of Trailers. No more than eight trailers shall be used per train while transporting material in dock or shop areas.

4. Ordnance

1. In the event of fire involving a crashed aircraft in which live bombs are carried, all firefighting and rescue operations shall be discontinued and withdrawal to a safe distance made if the fire is not under control within 3½ minutes.
2. Aircraft crash firefighting crews will be thoroughly instructed in fighting fires involving aircraft with live ammunition or ejection seats.
3. Crash crew personnel will be kept informed as to whether or not the aircraft is carrying live ammunition.

5. Fire Drills

1. Crash fire crews will be trained by periodic practice fire drills.
2. Standby fire apparatus shall be manned and ready to operate.
3. Smoking shall be prohibited in the immediate area.
4. All station activities having a crash phone connection shall be notified.
5. Gasoline shall be poured on ground or fuselage from an open container. Drums may be emptied by laying on their side and allowing free flow from bungs. Care shall be taken to prevent sparking when handling drums and opening bungs to release gasoline.
6. Personnel handling gasoline shall be clothed in full firefighting gear.
7. The fire chief or assistant will be in charge at all times.
8. No loitering will be done in a gasoline spill area.
9. Setting fire to gasoline or oil spills shall be done only after: all personnel and fuel containers are clear of the fire area; standby fire apparatus is manned and ready to operate; assurance that no low-flying aircraft will pass in line of smoke or fire.
10. Spill fires shall be ignited by throwing a torch in the spill area or, in the case of large spills, by use of a Very pistol.

03214 DANGER MARKINGS

1. **Airfield.** The following standard markings will be used for dangerous areas on all airfields:

1. Small holes and soft spots on the usable portion of landing fields shall be marked by day with yellow flags or yellow pyramids and by night with red lights to warn incoming pilots that the particular spots so marked are unsafe for landing.
2. When relatively large areas are unsafe for landing they shall be outlined by day with yellow flags and by night with red lights.
3. The fact that the entire area outlined is unusable shall be indicated by placing in its approximate center, by day, a relatively large cross made up of yellow flags or strips of yellow fabric, and at night, red lights.
4. Whenever a well-defined runway is closed, a large cross made of yellow flags or yellow strips of fabric shall be placed at each end of the runway in sufficient numbers to make certain that the cruciform arrangement is clearly distinguishable. The crosses prescribed shall be large enough to warn visiting pilots that the area or runway is unsafe for use. A large number of individual markers shall not be used because they make it impossible for a pilot to determine which area is to be used and which avoided.

2. Closed Targets. In order to give more adequate security to personnel engaged in repairing closed targets, the following system of visual signals will be used:

1. Closed land target—two yellow strips, 3 feet wide and 200 feet long shall be placed in the shape of an X adjacent to the target.
2. Closed water target—yellow dye shall be placed in the water immediately surrounding the target.
3. If a pilot fails to recognize the above visual signals and commences his run on a closed target, standard red parachute flares shall be fired by the repair crew as an emergency signal.

03215 ORDNANCE**1. General**

1. When conducting operations with or handling ammunition, pyrotechnics, or explo-

sives, the current applicable ordnance pamphlets, and instructions of chapter 20 of this manual shall be consulted and complied with.

2. Areas in which explosives and ammunition are stored, and areas in which operations involving explosive hazards are being conducted, shall be designated as restricted areas and properly placarded and guarded.
3. Ordnance materials shall be handled only by authorized personnel.
4. Safety devices provided for ordnance materials shall be used according to instructions.
5. Ammunition shall be fired only in the device or gun designated for that ammunition.

2. Handling

1. Handling of ammunition and explosives shall be kept to a minimum and shall be conducted with the utmost care at all times.
2. A red flag (International "Baker") shall be flown whenever explosives are being handled.

3. Fire Safety. All measures for the prevention and control of fires shall be taken in areas containing explosives and in areas immediately adjacent to them.

4. Weapons Aboard Aircraft

1. When loading, arming, dearming, or making safe ordnance equipment aboard aircraft, the safety precautions for the weapon being loaded, handled, or serviced shall be observed.
2. Aircraft with loaded guns or live rockets shall be pointed clear of other aircraft, hangars, and personnel insofar as practicable.

03216 MAINTENANCE OF GROUNDS

1. Roads and Walkways. Roads and walkways should be unobstructed and well defined. When required, adequate illumination shall be provided.

2. Construction. Construction hazards on the grounds, such as excavations, shall be clearly

identified by signs and suitable barriers erected around them.

03217 AUTOMOTIVE EQUIPMENT

1. Vehicle Markings. Uniform requirements for the marking of vehicles used on landing areas, taxiways, and aprons will be observed.

a. AMBULANCES. Ambulances used on the airfield will be painted in accordance with the Bureau of Yards and Docks requirements.

b. CRASH RESCUE AND FIREFIGHTING EQUIPMENT. Crash rescue and firefighting equipment used on the airfield shall be painted red.

c. SERVICE, MAINTENANCE, AND CONSTRUCTION EQUIPMENT. Service, maintenance, and construction equipment used regularly on the airfield will be painted chrome yellow. Front and rear bumper plates will be painted in alternate stripes of chrome yellow and black in accordance with applicable regulations. This requirement does not apply to ground support equipment of Fleet Marine Force Aviation Units subject to deployment to forward combat areas where camouflage is required. Such equipment shall carry the checkered flag specified in Article 03217, 1.d, below.

d. MISCELLANEOUS VEHICLES. All vehicles not regularly used on the airfield should carry a flag 3 feet square attached to a staff and flying above the vehicle whenever operations on the airfield are necessary. The flag will consist of a checkered pattern of international orange and white squares not less than one foot on each side.

2. Authorized Equipment. The amount of automotive equipment authorized on flying fields should be reduced to the absolute minimum.

3. Operating on Airfield

a. PARKED AIRCRAFT. Vehicles should not pass underneath any part of an airplane on the ground. Where such passing is absolutely necessary, the vehicle will come to a complete stop and, before proceeding, a visual check will be made to ensure that sufficient clearance exists.

b. PASSENGERS. Vehicles carrying passengers will stop only at the boarding entrance and well clear of an airplane while loading or unloading passengers.

c. TAXIING AIRCRAFT. No vehicles will stand or drive into the path of a taxiing aircraft

except the authorized guide or "follow me" vehicle.

d. AIRCRAFT ENGINE RUN-UP. No vehicle will stand, park, or drive in the danger areas of an aircraft while its engines are in operation.

Section 5

INFLIGHT SAFETY OF AIRCRAFT

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03501 PILOTS

1. **Authorization.** Commanding officers shall permit only those persons to pilot aircraft whom they consider competent and qualified to do so.

2. **Responsibility.** A naval aircraft taken into the air shall be commanded by a Naval Aviator, Naval Aviation Pilot, or other person authorized by the Chief of Naval Operations. The pilot in command of the aircraft is responsible for the safe and orderly conduct of the flight. The authority and responsibility of the pilot in command exists from the time he enters the aircraft preparatory to flight until he leaves it upon completion of the flight.

3. **Training.** No flight training in Navy or Marine aircraft shall be given to any individual without the specific authorization of the Chief of Naval Operations, the Chief of Naval Personnel, or the Commandant, United States Marine Corps. This does not prohibit regularly assigned aircrew members from being given sufficient instruction to maintain an aircraft in the air satisfactorily while the pilot is engaged in other duties.

03502 PASSENGERS

1. **Identification.** All passengers shall be identified by appropriate means and their presence aboard the aircraft listed and recorded in the manner prescribed by the Chief of Naval Operations.

2. **Status of Personnel.** All personnel aboard the aircraft will be either in the status of the aircraft's crew or of passengers, and this status shall be definitely understood and recorded prior to the flight.

3. **Safety and Survival Equipment.** Passengers shall be instructed prior to take-off on such passenger safety and survival equipment as is

required for that particular aircraft in which they embark.

03503 FIRE HAZARDS

1. **Smoking.** Smoking in aircraft is forbidden under the following conditions:

1. during fueling operations, including transfer and jettisoning;
2. during and immediately after take-off;
3. immediately before and during landing;
4. whenever any gas fumes are detected in the aircraft;
5. during all ground operations;
6. in the bomb bay or the fuselage or hull compartments which contain gasoline tanks;
7. in the cabin when cargo of a flammable or explosive nature is aboard;
8. during inspection of aircraft compartments wherein gas or other flammable fumes may have collected;
9. whenever oxygen equipment is in use.

2. **Fuselage and Hull Tanks.** In aircraft where fuselage or hull tanks are installed smoking shall be permitted in compartments adjacent to the fuel tank compartment(s) only when all doors and ports of such compartment(s) are secured.

3. **Instructions to Passengers.** For aircraft regularly employed in transporting passengers, appropriate orders and regulations shall be promulgated by the responsible commands with due regard for the fire hazards involved in the types of aircraft in use. These orders and regulations shall be prominently displayed in the aircraft. The orders shall be enforced by the pilot in command of the aircraft. He is empowered to prohibit smoking at any time or in any part of the aircraft when he deems such action necessary.

4. Flammable or Toxic Liquids. Alcohol or other flammable or toxic liquids shall not be used in any cabin or compartment of an aircraft for any purpose not specifically and officially authorized.

03504 CHANGE IN CONTROL OF AIRCRAFT

Piloting control of an aircraft will be changed only in the conventional manner prescribed by the Chief of Naval Operations.

03505 AIR TRAFFIC RULES

1. Civil. The Civil Aeronautics Board (CAB) is charged under the law with prescribing the air traffic rules governing the flight of aircraft, including safe altitude of flight and the prevention of collision. These rules are promulgated as Civil Air Regulations and are binding on naval personnel in the operation of naval aircraft over United States territory except when appropriate military authority determines that military necessity requires noncompliance.

2. Military. In addition to the air traffic rules promulgated by the Civil Aeronautics Board, naval aviators and aviation pilots shall be governed by regulations prescribed by the Chief of Naval Operations for the operation of military aircraft.

03506 AERIAL MANEUVERS

1. Maneuvers Authorized. Only maneuvers permitted for the particular aircraft by instructions and orders issued by the Chief of Naval Operations and the Bureau of Aeronautics will be permitted.

2. Acrobatics

1. Acrobatics will be performed only when duly authorized as prescribed by the Chief of Naval Operations.

2. Only personnel with current orders to duty involving flying will be permitted in naval aircraft performing acrobatics.

03507 AEROLOGICAL AND NAVIGATION INFORMATION

1. Display Boards. Display boards to indicate general flying weather conditions will be posted in the manner prescribed by the Chief of Naval Operations.

2. Maps. A suitable aeronautical map corrected to show pertinent aeronautical information (such as all air space reservations, danger areas, caution areas, air space warning areas, civil airways, control zones, and such other information as prescribed by competent authority) shall be displayed where it can be readily seen by pilots as they prepare their flight plans.

3. Other Aids. Other flight-planning aids will be provided as required by the Chief of Naval Operations or other competent authority.

03508 AIRCRAFT SAFETY INSTRUCTIONS AND PLACARDS

1. Authorization. Only those safety placards and markings duly authorized by competent authority with regard for the potential hazards created thereby in confined spaces such as the cockpit will be used in or on aircraft.

2. Emergencies. Standard procedures for emergencies requiring bailout, ditching, and abandoning the aircraft shall be promulgated by all units operating aircraft. Appropriate instructions and placards will be maintained in all aircraft.

3. Distress Procedures

1. Distress radio frequencies, procedures, signals, and call signs may vary in different theaters of operations; hence, it is essential to be familiar with local operation orders and plans, fleet or force instructions, radio facilities, charts, etc.
2. A copy of the distress radio procedures and distress signals appropriate for the theater(s) of operation shall be carried in the cockpit of all naval aircraft, and they shall be used in time of peace regardless of the degree of radio silence which may be imposed during tactical exercises. In time of war, they shall be used as prescribed by competent authority and on special operations they may be amplified as necessary to cover local conditions.
3. A copy of the standard visual panel-type distress signals and procedures will also be carried in the cockpit of all naval aircraft.

railway cars, and shovels shall be equipped with proper grab irons, steps, and hand and footholds; they shall have railings on deck walks, and suitable running boards at the front and rear.

b. BRAKES. All locomotives, locomotive

cranes, and railway cars shall be equipped with hand, air, or steam brakes, and with brake rigging. Special care shall be exercised to maintain these devices in an efficient condition.

c. ARRESTERS. Where coal-burning steam

Section 2

MOTOR VEHICLES

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Subsection A

ADMINISTRATIVE RULES

04201 DEFINITIONS

As referred to in this section, the following definitions will apply:

1. Motor Vehicle. A mechanically propelled conveyance, not operated on rails, by which any person or property may be transported upon a roadway.

2. Emergency Vehicle. Vehicles identified and authorized for use in accident prevention, protection, security, crash and rescue work, and those designated for emergency public works service.

3. Truck. A motor vehicle designed for the transportation of property.

4. Truck Tractor. A motor vehicle designed for drawing other vehicles and not so constructed as to carry a load other than a part of the weight of the vehicle and load so drawn.

5. Trailer. A vehicle without motive power designed for carrying persons or property and for being drawn by a motor vehicle.

04202 OPERATORS' QUALIFICATIONS AND REQUIREMENTS

1. Responsibility. The operator of a Navy or Marine Corps vehicle will be responsible for the safe operation of the vehicle while it is assigned to him, and for the safety of his passengers and cargo. Should a passenger refuse to cooperate with the safety instructions of the activity, the operator shall not move the vehicle but shall immediately report

the incident to the nearest appropriate supervisory authority.

2. Operator's Permit. No person, military or civilian, shall be permitted to drive a Government vehicle until such person has been examined and issued a permit in accordance with Navy Civilian Personnel Instruction 190.9. Strict adherence to NCPI directives concerning records and accident reports is required.

3. Inspection and Maintenance of Vehicles. Motor vehicles shall be maintained in a safe condition and no operator shall be permitted or required to operate a vehicle known to be unsafe. Operators of Navy or Marine Corps motor vehicles shall make the daily and weekly inspection or maintenance of the items listed on DD form 110, Vehicle and Equipment Operational Record. Inspection findings and recommendations should be reported in the space provided, before, during, and after operation.

4. Compliance With Local Ordinances. Motor vehicle operators must obey all local traffic laws and ordinances, use and observe the hand signals authorized for turning and stopping, and comply with all traffic signs and signals. It is not intended that the rules given in the following articles shall conflict with any local laws or ordinances. In case of such conflict, the local law or ordinance will prevail. In countries where driving on the left

side of the road is customary and legal, these rules shall be adapted to said custom or law.

5. Hours of Work. Except in extreme emergencies, where no relief is available, drivers of motor vehicles shall not be required to perform driving duties for long periods, because they may cease to be mentally alert and physically capable of driving safely. Drivers should not be required to perform driving duties, except for short hauls, following a full day of fatiguing work.

6. Physical Fitness. No operator whose alertness is impaired by fatigue, illness, alcohol, drugs, or who is otherwise physically unfit may drive a Government vehicle. If an operator is on the road and feels that he is becoming fatigued or drowsy, he shall pull off the road and stop for a few minutes of rest.

7. Courtesy. Motor-vehicle operators are expected to practice "courtesy of the road" at all times toward drivers of other vehicles and toward pedestrians.

Subsection B

SAFETY OF THE ROAD

04211 BASIC RULES ON THE ROAD

1. Speed Regulations

a. LOCAL SPEED LIMITS. No motor vehicle shall be driven at a speed greater than the maximum limit allowable in the area or posted on the roadway.

b. RECKLESS DRIVING. No motor vehicle may be driven recklessly or in such a manner as to endanger life, limb, or property.

c. REDUCING SPEED. No motor vehicle may be driven at a speed greater than is reasonable and prudent, giving due regard to the type of vehicle, visibility, traffic, or any other existing condition or circumstance, such as:

1. approaching and crossing an intersection or railway grade crossing;
2. approaching a drawbridge or lift bridge;
3. approaching and going around a curve;
4. approaching a hill crest;
5. traveling in any narrow, winding roadway;
6. driving on a wet pavement, over snow or ice, or through rain, snow, sleet, fog, mist, dust, or smoke.

d. MINIMUM SPEEDS. No motor vehicle shall be driven at a speed so slow as to impede or block the normal, reasonable movement of traffic, except when reduced speed is necessary for safe operation.

2. Correct Lane. A motor vehicle shall be driven as nearly as practicable entirely within

the right-hand lane and shall not be shifted from that lane until the driver can accomplish the move with safety. Driving may be shifted to another lane under the following conditions:

1. when overtaking and passing another vehicle proceeding in the same direction;
2. when the right half of the roadway is closed to traffic because of construction or repairs;
3. when a roadway is marked for one-way traffic;
4. when the roadway is divided into three or four lanes and marked for traffic under the rules applicable thereon;
5. when preparing for a left turn at an intersection, a private road, or a driveway.

3. Safe Following Distance. The operator of a motor vehicle shall not follow another vehicle more closely than is reasonable and prudent, having due regard for the relative speeds of the vehicles, the amount of traffic, the conditions of the highway, visibility, and the type of vehicle directly ahead. When following fire apparatus responding to an alarm or other emergency vehicles, automotive traffic shall keep at least 500 feet to the rear of such vehicles.

4. Overtaking and Meeting Vehicles

a. MAINTAINING SAFE CLEARANCE. When overtaking another vehicle proceeding in the same direction, an operator shall pass to the

d. PARKING AT THE SCENE OF FIRE. Fire apparatus shall not be parked or left standing at the scene of alarms in such a manner as to unduly obstruct traffic, and free flow of traffic shall be established as soon as possible.

e. RETURNING TO FIRE STATION

1. Motor fire apparatus, when returning from an alarm of fire, shall be driven as nonemergency equipment and the drivers shall abide by all traffic regulations of the station, and of state and local traffic laws when off the station.
2. When fire apparatus is being backed, whether into the fire station or at any other time except in an emergency, a man must stand on the rear platform or to the side and rear of apparatus to safely guide the driver.

4. Trucks and Trailers

a. CHECKING EQUIPMENT BEFORE OPERATING.

No trucking equipment shall be operated unless it is in good repair and all safety devices are in proper working condition. Hood fasteners, brakes, brake fluid, headlights, horn, windshield wiper, king pins, breakaway brakes, etc., shall be inspected and repaired. All tires on dual wheels shall be matched as to size, weight, load capacity, and air pressure. Trucks and tractors equipped with air brakes shall not be operated unless the motor is running and the air pressure is at least 60 pounds. Trucks that operate during hours of darkness shall be equipped with proper headlights, tail lights, and running lights.

b. LOADING

(1) *Maximum Size of Load.* No motor vehicle shall be loaded beyond its rated capacity. Further, the load shall not obscure the operators' view ahead or to either side, or in any way interfere with safe operation. Where loads overhanging the sides of vehicles are transported within a shore activity, special precautions shall be taken to prevent collision between the overhang of the load and another vehicle. Minimum precautions shall consist of walking flagmen or escort vehicles. Where overhanging loads are to be transported over the public highway, clearance shall first be obtained from local civil authorities and if a civil

police escort is not provided for the vehicle the activity shall provide an adequate escort. Movement of overweight or oversized loads or equipment shall be accomplished in accordance with instructions in *NAVDOCKS P 300, Management of Transportation Equipment.*

(2) *Distributing the Load.* Heavy loads must be properly distributed. Incorrect distribution may overload individual tires or axles even though the weight of the load is within the rated capacity of the vehicle.

(3) *Securing the Load.* The load of a vehicle should be so arranged that none of the cargo can drop, shift, leak or otherwise escape. The load must be braced and stayed with proper lines, chains, dunnage or other fittings. The operator is responsible for the load and is authorized to refuse cargo that is improperly loaded. Side stakes and tailgates or end stakes of trucks and trailers shall be installed securely in place whenever material or personnel are being transported. Header boards or similar devices of sufficient strength shall be used where nature of cargo is likely to crush or penetrate driver's compartment due to rapid deceleration or accident.

(4) *Warning Signs.* A motor vehicle carrying a load which projects more than 4 feet beyond the rear of the vehicle shall display at night, or whenever visibility is reduced, a red light at or near the end of the projecting material. At other times, a red flag not less than 12 inches square should be displayed in place of a red light.

(5) *Loading a Dump Truck.* The operator of a dump truck shall not sit in the cab of the truck while it is being loaded by a power shovel, crane, derrick, or similar device. He should leave the driver's seat and remain outside the reach of the dipper or bucket until the truck has been loaded.

(6) *Hauling of Heavy Loads.* No vehicles hauling an unusually heavy load over a highway or within a municipality shall be moved until the operator has been advised of the correct weight of the vehicle and load, and given specific instructions as to the route which he is to follow (one which has previously been chosen as safe and legal).

c. TOWING

(1) *Safety Chains or Cables.* No truck or tractor shall pull or tow a draw-bar type trailer or non-self-propelled equipment over highways, roadways, or streets, unless the towing and towed vehicles are coupled together with at least one safety chain or cable in addition to the trailer tongue or draw-bar of the towed vehicle. The chain or cable shall be so connected to the towed and towing vehicles and to the tow-bar as to prevent the tow-bar from dropping to the ground in the event the tow-bar or its connections fail. The means of attachment to both the towing and towed vehicles shall be capable of withstanding the ultimate strength of each safety chain or cable. Each chain or cable shall have an ultimate strength at least equal to the combined weight of the cargo and trailer being towed. Every full trailer and every dolly used to convert a semi-trailer to a full trailer shall be equipped with a chain or cable, provided with a thimble, ring or other suitable means for attaching it to the towing vehicle. Attachments for the safety chain or cable shall be mounted in the vertical plane of the longitudinal centerlines of the tow-bar, towed, and towing vehicles. This precaution does not preclude the use of double chains when the situation warrants. When the situation warrants use of double chains, no more slack shall be left in the safety chains than is necessary to permit proper turning. (This precaution is not intended to include materials handling trailers as shown in Figures 31, 32, 33, and 35 of publication NAVSANDA-284 (NAVMC 1101).)

(2) *Air Brakes.* Truck or tractors equipped with air brakes shall tow only trailers equipped with air brakes. Coupling of vacuum brake unit to air brake unit is strictly prohibited.

(3) *Air Connections.* No truck or tractor shall pull or tow any trailer until proper air connections are established between the two units.

5. Dempster-Dumpster**a. OPERATING PRECAUTIONS**

(1) *Dumping.* The operator shall not permit any other person to be on the truck or near the rear of the truck during the dumping operation.

(2) *One-Man Operation.* No person other than the operator shall hook or unhook chains or perform any other operation pertaining to the hoisting, loading, or dumping operation. The hoist truck is designed to load, dump, and unload all containers as a one-man operation. If the operator cannot perform these operations *unaided*, he shall proceed immediately to the maintenance shop and report the circumstances.

(3) *Removal of Lodged Material.* Each truck shall carry a long-handled implement to dislodge any material which remains in the container after dumping. No person other than the operator shall use such implement at the dumping ground. If any material cannot be readily dislodged by the operator, he shall hoist the container and take the truck to the maintenance shop where mechanics shall free the material, using jacks, props, or auxiliary hoists as necessary, to prevent uncontrolled closing of the container.

(4) *Mechanical Failure of Equipment.* An operator shall not attempt to use expedient methods to hoist, load, or dump a container when any malfunction occurs. Instead, he shall take it to the maintenance shop, if possible; if not, leave the container and report the circumstances.

(5) *Entering Container When Off the Ground.* No person shall be permitted to insert any part of his body into a container when it is off the ground. Each container shall carry a sign reading: WARNING—STAY CLEAR AT ALL TIMES WHEN CONTAINER IS OFF THE GROUND.

b. MAINTENANCE

(1) *Hoisting Mechanism.* Hoisting mechanisms shall be inspected in accordance with Bureau of Yards and Docks' maintenance schedule to ensure that:

1. Hoist arms are parallel under load;
2. Lift chains are straight, the same length under load, and with no defective links;
3. The hydraulic system is tight, the moving parts in proper alignment, and that there are no loose parts;
4. The hook and spring assembly is clean, and free of rust, dirt, oil and grease. This assembly does not require lubrication.

tion. Hook springs shall be replaced when found to exert less than 30 pounds pressure on the hook in the engaged position. When hook points become worn or flattened, they shall be built up by welding;

5. The hoist will load, hook, dump, unhook, and lower a fully loaded container solely by means of the operating controls in the cab.

(2) *Bails*. Bails on trash containers shall be inspected before each use. If bails are found to be bent toward the containers more than one-quarter inch, or are excessively deformed in any manner, they shall be straightened or replaced. Particular attention should be given to the welds attaching the bails to the container.

(3) *Lifting Trunnions*. Lifting trunnions in each end of all containers shall be inspected in accordance with Bureau of Yards and Docks' maintenance schedule to determine that they are securely welded and properly aligned.

c. MODIFICATIONS

(1) *Mirrors*. All refuse container hoist trucks shall be equipped with rear view mirrors on both right and left sides of the cab.

(2) *Hoist Hook*. The hoist hook shall not operate by gravity or any type of spring action other than a positive acting torsion spring.

(3) *Equipment Changes*. Any proposed modification to the hoist mechanism or the containers, other than as indicated above, shall be submitted in full detail to the Bureau of Yards and Docks for technical approval prior to installation.

04214 SAFETY FOR RIDERS

1. Restrictions on Riders

a. UNAUTHORIZED RIDERS. Under no circumstances shall unauthorized persons be allowed to ride on a motor vehicle.

b. CROWDING THE OPERATOR. In addition to the operator there shall be permitted in the front seat of a motor vehicle only the number of passengers for which the seat was designed.

c. STANDING. Standing in moving vehicles is prohibited except in buses provided with handholds or straps.

d. CONTAINMENT OF PASSENGERS WITHIN VEHICLE. Under no circumstances shall any person be permitted to ride with arms or legs extended outside any vehicle, to ride on running boards, or to be seated on fenders, the top of the cab, cab shields, or the rear of the load, except when the vehicle is designed and has provision for such purpose.

2. Restrictions on Vehicles Used. Cargo-carrying vehicles shall not be used to transport personnel while loads are being carried unless the cargo is secured against shifting in transit and special provisions have been made for seating personnel. Within Government reservations, empty trucks or trailers with side racks or stakes in place may be used to transport small groups (less than 12 persons) of seated passengers for short distances. Under emergency conditions, empty trucks or trailers without seats may be used to transport personnel when operated with special caution, relating speeds to road surface conditions and alignment. Trucks regularly used to transport personnel shall be equipped with seating facilities which are secured and with a rear endgate or guardrail properly secured. Such trucks shall not be moved until the operator has checked to see that all persons are seated and that required guardrails and endgates are in place. The use of dump trucks for transporting personnel is not recommended. If such use is required by station exigencies, the following steps shall be taken.

1. Positive means to prevent the raising of the truck bed while in transit.
2. Provision of a safe seating arrangement and access ladder.

3. Carrying Equipment on Vehicles With Riders

a. STOWAGE OF TOOLS. Tools and equipment carried on a motor vehicle which also carries riders shall be properly stowed and fastened.

b. PROHIBITION AGAINST EXPLOSIVES. No explosives, flammables, or toxic substances shall be transported in a vehicle while it is being used to carry riders other than authorized workmen.

4. Protection in Cold Weather. All open motor vehicles transporting personnel during cold or inclement weather shall be provided

with a tarpaulin or other suitable covering.

5. Loading and Unloading Personnel. No person shall be permitted to get on or off a motor vehicle while it is in motion. Vehicles shall be brought to a complete stop before loading or unloading passengers.

04215 TRANSPORTING EXPLOSIVES

The transportation of explosives is extremely hazardous by any method, and the dangers of transporting by motor vehicles are multiplied because of the high rate of highway accidents. All rules for road safety must be carefully studied by operators of motor vehicles carrying explosives, and in addition the special precautions of this article shall be closely followed.

1. Applicable Regulations. The transportation of explosives shall be in compliance with Interstate Commerce Commission regulations and any local, State, and municipal regulations which apply to highway transportation. The provisions of Ordnance Pamphlet No. 5, Volume 1, Chapter 9, Paragraphs 0924 through 0935 also apply.

2. Qualified Personnel. Every vehicle used for the transportation of explosives shall be under the supervision of and operated only by a person who is properly qualified, physically fit, careful, reliable, and able to read signs and labels written in the English language or language prevailing in country or countries being traversed. No person other than the authorized driver, one helper or relief driver, and a courier (where required for classified material) shall be permitted to ride on a vehicle transporting explosives.

3. Preparation of the Vehicle

a. VEHICLE INSPECTION. Vehicles used in the transportation of explosives shall be inspected immediately before use in accordance with *NAVWEPS OP2165* (2nd Rev.), Article 0403 and *NAVWEPS OP2239* (1st Rev.), Article 404.

b. FLOORS. The floor of each vehicle used in the transportation of explosives shall be tight, substantially constructed and free of unnecessary holes and openings. They must be of wood or have that portion of the interior which is in contact with the load lined with either non-metallic material or non-ferrous metals. Skids,

wood pallets and other appropriate loading devices may be considered as flooring and sufficient to meet the requirements stated. Floors shall not be permeated with oil or gasoline, or other combustible materials.

c. FIRE EXTINGUISHERS. Each Navy vehicle used for the transportation of explosives shall be equipped with two, full, ten-pound portable dry chemical fire extinguishers. They shall be properly filled, securely mounted on brackets, and located so they are readily accessible and easily removed.

d. WARNING SIGNS. Vehicles used for the transportation of explosives on or off the station shall carry four placards appropriate to the load (i.e., *Explosives* for Class A and *Dangerous* for Class B explosives, etc.). They must be printed in letters at least 8 inches high and set in contrasting backgrounds. One placard shall be placed on each side, on the front, and on the back of the loaded vehicle. The letters or the background must be light reflecting. The front placard shall not have any red-reflecting color. Each vehicle shall also be provided with two red flags and appropriate stands and with three electric flares or reflectors, to be used in case of emergency stops as described in Article 04212.

4. Loading and Unloading Explosives

a. RESTRICTIONS ON LOAD

(1) *Keeping to Rated Capacity.* Vehicles used for transportation of explosives shall not be loaded beyond their manufacturer's rated capacity, and in no case shall the explosive container be piled higher than the closed sides and ends of the body. If the vehicle has an open body, the sides and ends shall be securely fastened and the explosives shall either be covered with a fire, water, and weather resistant tarpaulin or be packed in containers that are fire, water, and weather resistant.

(2) *Carrying Other Substances.* No metal, carbides, oil, firearms, electric batteries, flammable substances, acids, or oxidizing or corrosive compounds shall be carried in the body of any vehicle while it is being used for transporting explosives. Tools may be carried provided the explosives are properly packaged; and provided that the tools are separated from

the explosives by bulkheads and so secured in place as to prevent damage to the explosives or packaging thereof. Ordnance Pamphlet No. 5, Volume I, Chapter 9, Paragraph 0927.11 also applies.

b. CARE DURING LOADING AND UNLOADING

(1) *Stopping Engine.* The engine of a vehicle shall be stopped during loading or unloading of explosives. Packages or containers of explosives unloaded from a vehicle shall be placed at a sufficient distance from the exhaust to prevent the danger of engine sparks igniting the explosives.

(2) *Proper Handling.* Packages or containers of explosives shall not be thrown or dropped while being loaded or unloaded. They shall be carefully deposited and stored or placed in such a manner as to prevent the packages or containers from sliding, falling, or being displaced. When being unloaded they shall be stored directly in a magazine or a responsible person shall be put in charge of them.

(3) *Provision for Loading Dynamite.* If State and local laws permit, dynamite and detonators may be transported in the same vehicle provided that the amount of dynamite in such instances does not exceed one case (50 pounds) and the number of detonators does not exceed 100. When dynamite and detonators are transported in the same vehicle they shall be separated by a divider of not less than 4-inch hardwood or material of equivalent resistance. Separate vehicles shall be provided for the transportation of more than one case (50 pounds) of dynamite or more than 100 detonators.

5. Safety in Driving

a. WEATHER CONDITIONS. Explosives should not be transported during hours of darkness or during adverse climatic conditions except in an extreme emergency and then only with the written approval of the proper authority and when all precautions have been taken.

b. AVOIDING CONGESTED AREAS. Transporting explosives through cities, towns, and other congested areas shall be avoided when possible. When unavoidable, the proper official of the area should be advised of the proposed trip in

order to assure the use of the most desirable thoroughfare and to provide an escort if necessary.

c. DRIVING SPEED. Vehicles transporting explosives shall be operated with extreme care and shall be driven at a safe speed not to exceed 45 miles per hour except that minimum state speed limits shall be observed.

d. stops. When explosives are being transported, no unscheduled stops shall be made. At scheduled stops the vehicle shall never be left unattended and the driver shall not leave the controls without first ascertaining that the parking brake has been securely set and all reasonable precautions have been taken to prevent movement of the vehicle. Stops for refueling, crossings, and emergencies shall be in accordance with the following rules:

(1) *Railway Crossings.* Before crossing at grade level of any railroad track or tracks, the operator of any motor vehicle carrying explosive substances or flammable liquids shall stop his vehicle, preferably within 50 feet but not less than 15 feet from the nearest rail of such railway; while stopped he shall look and listen in both directions for approaching trains, and shall not proceed until he can do so safely. Upon proceeding he shall cross only in such gear of the vehicle as will make unnecessary a change of gears while on the tracks. No stop need be made at any such crossing where a police officer or traffic-controlled signal directs traffic to proceed.

(2) *Refueling.* The gasoline tank of a vehicle shall not be refueled while explosives are in the vehicle except in an emergency, and then only after the engine of the vehicle is stopped, all lights are extinguished, and suitable ground for static electricity is attached.

(3) *Emergency Stops.* If an explosive-carrying vehicle becomes disabled in any way the operator shall, if possible, drive it off the street or highway before coming to a stop. If this is not possible, two red flags in stands (in the daytime) or two electric flares or reflectors (at night) shall be so placed on the street or highway in the line of approaching traffic as to provide visibility for a distance of not less than 500 feet ahead and behind the

stopped vehicle, and one red flag (in the day-time) or electric flare or reflector (at night) at the side of the vehicle to indicate restricted clearance for passing traffic.

6. Use of Public Garage. A vehicle containing explosives shall not be taken into a garage or repair shop, nor parked in a congested area, nor stored at any time in a public garage or similar building.

7. Radios. Radio-frequency energy of any

type may cause inadvertent initiation of ordnance components. Motor vehicles equipped with radio transmitters shall not transport electric blasting caps and other electrically fired ordnance. Radio transmitters in any motor vehicle shall not be operated within 25 feet of any area where electric blasting caps are located and radio transmitters with an output of 250 watts or more shall not be operated within 100 feet of such areas.

Subsection C

GARAGE SAFETY

04221 GENERAL HOUSEKEEPING

1. Cleanliness

a. FLOORS AND OTHER EXPOSED AREAS. The distribution center, garage, or workshop shall be thoroughly inspected daily and maintained in a clean and orderly state. Floors and other exposed surfaces shall be kept scrupulously clean. Hazards on floors such as oil, grease, or loose tools, which might result in fire, slipping, tripping, or falling shall be eliminated as quickly as possible.

b. GREASE RACK. Particular care shall be taken to maintain cleanliness in the area around the grease rack as well as in the rack itself. Be sure that grease connections are fast to car connections when greasing a car. At the close of business each day, clean the grease rack and floor.

c. WALKS AND DRIVES. Loose stones or gravel on walkways and driveways shall be removed daily. Keep walks and drives free of ice in winter, and remove icicles from the eaves.

2. Ventilation. Garages and repair shops should be well ventilated for protection against carbon monoxide gas from running engines. If the shop cannot be sufficiently ventilated to ensure maximum safety, a vehicle should be driven outside as soon as its engine has been started.

3. Illumination. Adequate illumination shall be provided and utilized for all general work areas, including work benches, lubrication pits, and other work locations. For minimum lighting required in specific situations see chapter 2, article 02204.

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United States Navy
SAFETY PRECAUTIONS

Chapter 5
SEAMANSHIP

01104 BASIC RULE OF RESPONSIBILITY

Safety is a command function. Responsibility for the safety of personnel is vested in the commanding officer. Because these safety precautions apply only to usual conditions, commanding officers or others in authority may find it necessary to issue special precautions to their commands to cover local conditions and unusual circumstances. In addition to the posting of appropriate precautions, careful instruction and indoctrination of all personnel are necessary to ensure effective compliance with these precautions.

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are working over the side, life buoys with line attached shall be available.

2. Men are not permitted to sit or lean on the lifelines.
3. In maneuvering alongside a dock or during drills or evolutions, personnel are required to keep well clear of lifelines.
4. When lifelines are removed for an extended period, officers and petty officers concerned are required to ensure that emergency lines are rigged to protect personnel.
5. At sea, and in port under hazardous conditions of sea and weather, men are not permitted to work over the side without a life jacket with a safety line attached and properly tended by another person on deck. Men having occasion to work outboard life lines in rigging or unrigging a brow, boat or other gear, or in ships' boats any part of which is outboard life lines, shall wear life jackets.
6. Ring buoys with a line attached shall be kept available for use when sea or Jacob's ladders are being used.

7. Bin Covers. Bin covers shall be provided with safety latches or props, so that they will not fall on personnel.

8. Propellers. Before permission is given the engine room to turn over a propeller, the following safety precautions shall be taken:

1. Check all mooring lines and take in slack.
2. Remove men working in the vicinity of the propeller.
3. Maintain a bridge watch during the entire time the propeller is being turned over in order to stop the engine in case lines should part.

9. Smokestacks

1. Except in cases of emergency, personnel shall not be permitted to perform work on the smokestack when a ship is underway.
2. In the event that work must be done, precaution shall be taken to prevent blowing tubes, lifting safeties, or blowing of the whistle.
3. Boatswain chairs shall be used instead of swinging staging.
4. A brass warning plate must be affixed in plain sight to all smokestacks cautioning personnel about the poisonous gases and fumes therein.

10. Nylon Rope. The loading and handling characteristics of nylon rope are quite different from those of manila and other natural fiber ropes and certain precautions should be taken for the safe handling of nylon lines:

1. At the breaking point, nylon rope is stretched $1\frac{1}{2}$ times its original length and the resulting snap-back is hazardous. No one shall stand in the direct line of pull when heavy loads are applied.
2. To insure against overloading, a 40-inch length of cord should be attached to two points on the nylon line 30 inches apart. Loads should be kept below the safe working limit of line indicated by a taut cord.
3. To avoid sudden slippage when easing-out nylon line from bitts or cleats, two or three round turns should be taken before figure-eighting the line. Personnel shall stand clear of the line and bitt when performing these operations.

Subsection B

CARGO HANDLING

05111 INTRODUCTION

The safety regulations included in this section shall govern activity for all cargo handling. However, because of the special handling required for flammables and explosives (whether

they are handled as cargo, for fuel, or for other purposes), they are treated separately in subsection **c**. All personnel handling cargo consisting of flammables or explosives shall be familiar with the regulations of subsection **c**

and the references given there as well as with the following precautions.

05112 SAFETY FOR PERSONNEL DURING CARGO HANDLING

All personnel are required to board and leave ships by the gangplank or by other means provided when cargo is being handled. Boarding or leaving a ship via cargo-handling gear or by climbing up or down a save-all, is prohibited. When ships' holds are equipped with stairways these must be used in lieu of ladders. Entering or leaving ships' holds by means of ships' cargo-hoisting gear is prohibited. In areas where the handrails have been removed to make way for cargo, ropes must be used to block off the space to prevent personnel from falling overboard.

05113 PREPARING PIER AND CARGO GEAR

1. Pier Inspections. Pier flooring and structures should be inspected periodically. If defects are found, temporary repairs should be made immediately, and permanent repairs made as soon as possible. The pier must be in proper condition when used during loading operations.

2. Preparation and Maintenance of Ship's Gear

a. PROPER USE OF GEAR AND TOOLS

1. Ship's cargo hoisting falls or whips shall not be used for mooring or shifting berths.
2. Cargo falls or ship's hoisting gear shall not be used to move railroad cars on piers.
3. Cargo booms should be tested and have their approved capacity plainly marked in a conspicuous manner and place, preferably at the heel of the boom.
4. Chains must be in good condition before they are used for sling loads. There shall be no kinks in chains, they shall never be shortened by wiring or tying, and repairs shall never be made even temporarily by bolting two links together or by the use of wire.
5. Blocks, crowbars, chain slings, and other equipment must not be thrown from the deck to the ship's hold or to the pier.

b. MAINTENANCE OF GEAR. Inspection of ship's cargo gear should be made by the ship's crew before the gear is used for stevedoring

operations. The crew should give all assistance possible to keep ship's cargo gear in proper condition while it is in use.

c. RIGGING OF SHIP'S GEAR. See 09105 and 09122 for additional information concerning wire rope and rigging.

(1) Winding the Winch Fall. Whenever possible the winch fall should be so wound that the lever will have the same direction of operation as the load being handled.

(2) Making Fast Boom Guys and Preventers. The boom guys and preventers should be kept as far away from the heel of the boom as possible, but not past the line of the fall. They should be made fast in order to divide the strain. Preventers should be made fast around the head of the boom, independent of all other fastenings. Booms should always be topped so as to avoid undue strain on both the boom and the topping lift. Special caution should be used where the Samson or derrick post is low. The dragging of one fall against the other, without plenty of sag, is positively dangerous and must be avoided.

(3) Using an Additional Preventer. When the location of winch controls is such that they expose a winch driver to the bight of the fall, an additional preventer should be placed on the lead block at the heel of the boom. The preventer should be not less than 5/8-inch wire cable and preferably 3/4-inch or larger. Lanyards must be attached to beam bridles and used when handling beams or pontoon hatch covers.

3. Inspection and Preparation of Stevedore Gear

a. SAVE-ALLS. Save-alls must be stretched, hung, safely secured to both vessel and dock, and in line with each hatch when general cargo is being worked.

b. REPORTING DEFECTIVE GEAR. If tools, materials, appliances, or other gear are at any time found to be out of repair, defective, or unsafe in any way, this condition should be reported immediately.

c. INSPECTING THE GEAR. Stevedoring gear must be carefully inspected by designated and competent personnel before being issued for use. Any unsafe or doubtful gear must be discarded, marked, and so placed that it cannot be used by longshoremen.

05114 LOADING AND DISCHARGING CARGO**1. Preparing the Hatch**

a. CLEARING THE BEAMS. Only cargo which must be removed to clear the beams should be hoisted from the hatch until the hatch covers and strongbacks are off and stowed clear of working gear.

b. STOWING STRONGBACKS AND HATCH COVERS. Strongbacks and hatch covers should be stowed in such a way that they will not interfere with

a safe walkway for hatch tenders from rail to hatch coaming and will not be tipped by drafts or cargo into the hatches or over ship's side. If a safe walkway cannot be provided, two hatch tenders should be used.

c. USING ONE SECTION OF HATCH. If just one section of the hatch is being used, the strongback of the adjacent section shall be bolted to the hatch coamings or otherwise secured or re-

standard iron pipe-size screw thread on one end to fit the opening in a standard gasoline drum; the other end should be fitted with a Navy standard hose thread, to take a standard 1¼-inch inside diameter flexible metallic hose covered with rubber and fabric. This hose will be furnished in 25-foot lengths having couplings and nozzles with Navy standard threads. The standard gasoline-filling hose nozzle is of the "wet hose" type, which will release gasoline only when the operating lever is gripped and will automatically cut off the flow when the lever is released. This instantaneous control prevents overfilling of tanks. Overflow of the tank should be carefully avoided, especially on boats where the filling fitting is located in-board. However, in decked-over boats and motor launches the filling fitting is located on deck. Therefore overflowing gasoline will pass overboard and not into the bilges.

3. Fueling When a Boat Is in the Skids. In an emergency it is sometimes necessary to fuel a boat in the skids. For detailed precautions in such a situation see the *Bureau of Ships Manual*, chapter 82, paragraph 117(9). In addition, the following precautions shall be taken:

1. Adequate firefighting equipment shall be provided at the scene.
2. The fire main shall be under suitable pressure and hose led out to the scene from at least two fire plugs.
3. If practicable a metal hose, thoroughly grounded to the supply tank or drum and to the boat's tanks, should be used for transferring gasoline.
4. Where the use of a metallic hose is not practicable and a separate container must be used to pour gasoline into the boat's tanks, this container, the boat's tanks, and the supply tank or drum should be interconnected by a flexible conducting wire of

adequate length. Portable containers shall be inspected after emptying to insure that all gasoline has been drawn off and shall then be closed tightly by setting up on the filling and vent plugs.

05214 STARTING THE ENGINE AFTER FUELING

Before starting an engine after fueling, or before starting when the engine has been idle for a day or more, every precaution must be taken to ensure thorough ventilation. The same precautions shall be taken if gasoline vapor is noticed when the boat is under way. Gasoline fires have occurred through ignition by sparks from some part of the electrical equipment while the engine was turning over; therefore it is necessary to the safety of both personnel and material to stop the boat and clear out the gasoline vapor before continuing to run the engine. The following precautions shall be taken:

1. Fire extinguishing equipment shall be readily available, and a crew member shall be standing by ready to operate it if necessary.
2. If door or hatch openings are inadequate to supply sufficient ventilation, air circulation may be induced by fanning or using an air bellows.
3. Fuel lines shall be inspected for leaks and any that are found shall be corrected immediately.
4. The engine must be inspected for loose electrical connections, bare terminals, and damaged insulation. If any of these are found they must be reported to the boat electrician.
5. If gasoline has been spilled into the bilges during fueling the bilges shall be washed down, pumped, wiped out, and aired thoroughly before the engine is started.

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Subsection A

SUBMARINES

05301 PREPARATION FOR UNDERWATER WORK

1. Hazards. In underwater work involving diving or making ascents from any depth with a respiratory apparatus such as a diving suit or lung, the users of such devices are subject to abnormal conditions which, under certain circumstances have long been recognized to be hazardous; hence proper precautions are necessary. Air embolisms and bends are the greatest hazards met in underwater work, and conditions causing them, in addition to precautions against them follow:

a. BENDS.

(1) *Cause.* When compressed normal air, consisting of approximately 20 percent oxygen and 80 percent nitrogen, is breathed, the nitrogen is taken up in solution by the blood and tissues of the body. When the pressure is reduced the nitrogen is released by the tissues and blood in a gaseous state. If the release is sudden, the large bubbles formed collect around the ligaments, joints, and muscles and cause what is known as bends.

(2) *Prevention.* To prevent bends it is essential that the release of pressure beyond a certain stage be gradual. In diving work this is accomplished by requiring the diver, after he has ascended part way to the surface, to stop for proper desaturation at various stages and for certain periods throughout the remainder of the ascent.

b. AIR EMBOLISM. In ordinary diving work the possibility of air embolism in the diver is remote, as he is always hoisted to the surface at a proper rate. In individual escape from submarines, however, and in lung training, the possibility is greater. It could and probably would occur:

1. through a too rapid ascent,
2. by the subject, through fear or other cause, holding his breath during ascent,
3. by defective apparatus interfering with adequate breathing.

2. Training of Personnel. The prevention of bends and air embolism is dependent upon the physical fitness of personnel, the satisfactory functioning of the escape apparatus, and the proper decompression and gradual release of the intrapulmonic pressure in the body. Proper decompression and gradual release are the major objectives, and they can be attained by well regulated ascents. To assure proper methods, all personnel shall be well trained in use of the lung and shall fulfill the following requirements:

a. REQUIREMENTS OF INSTRUCTORS. Instructions should be given only by personnel trained and qualified in the use of the lung. An officer thoroughly familiar with the use of the lung and with training procedure should always be present when training is in progress. When escape training is under way, the officer in charge (or a qualified chief petty officer detailed by the

swim to the surface. Only a belt with a quick release shall be used.

4. The diver must remember not to duck the mask while on the bottom, except in an emergency, in which case he should exhale continuously while ascending. While at work he should always be in the clear, in order to permit direct ascent to the surface.

05326 Oxygen-helium Diving

The safety precautions covering procedures, equipment, and methods of working on the bottom when using standard equipment apply also to oxygen-helium diving. (See articles 05321 through 05324.) The following additional precautions shall be taken:

1. Preparing for the Dive

a. PREPARING AND CHECKING GAS. Oxygen-helium diving should not be undertaken until sufficient quantity of gas has been prepared and checked for proper composition.

b. CHECKING ASPIRATOR AND CANISTER. The aspirator and canister must be checked to see that they are functioning correctly. Fifty pounds of gas supply pressure over bottom pressure should be maintained.

c. VENTILATING THE HOSE. Before the diver is put down the hose should be ventilated to ensure that the diver is actually breathing a helium-oxygen mixture. The change in tone of the diver's voice as he begins to breathe helium is distinct and easily recognized.

2. Safety During the Dive

a. ASSURING ADEQUATE VENTILATION. If the diver develops symptoms of inadequate ventilation while on the bottom there should be no hesitation on his part to by-pass the venturi supply by periodically opening his control valve as conditions warrant. To compensate for this excess supply the chin button will have to be used more frequently to prevent blow up. When the diver reaches the surface an investigation for the cause of the faulty ventilation should be undertaken at once.

b. AVOIDING TOXICITY. While breathing oxygen at the 50- and 40-foot stops the diver must keep any form of exertion or exercise to a minimum, since activity increases susceptibility to oxygen toxicity.

05327 SELF-CONTAINED DIVING

1. General Precautions. In addition to the general safety precautions contained in Article 05322, the following precautions are applicable to all classes of SCUBA diving. Information as to limitations of diving duration and depths and other technical details is contained in the *U.S. Navy Diving Manual*, NAVSHIPS 250-538.

1. The "no decompression" limits of standard decompression table shall not be exceeded. Dives requiring decompression may be made if considered necessary by the officer-in-charge of the diving operations. Operational swimmers are authorized to dive to greater depths when operational requirements dictate and an officer-in-charge has made certain that personnel have been adequately trained and have sufficient experience to undertake the deeper dives. The total time of a SCUBA dive (including decompression) must never exceed the duration of the apparatus in use—disregarding any reserves.
2. The divers shall be briefed as fully as possible.
3. The minimum permissible surface crew shall consist of: one tender-timekeeper for every lone surface-tended diver; one tender-timekeeper for all buddy pairs in one vicinity; and one standby diver for all lone surface-tended divers.
4. The Buddy System shall be used whenever possible and continuous contact shall be maintained.
5. Where visibility is poor, a short buddy line shall be used to link each other together.
6. Each diver shall know the standard diving signals and any special signals and shall be alert for and acknowledge promptly any signal from his buddy diver.
7. The dive should be planned to avoid the necessity for decompression.
8. The location of the nearest recompression chamber shall be determined.
9. Divers shall always wear a life jacket

that has been approved for SCUBA diving. The life jacket must be worn under all equipment that can be jettisoned.

10. Immediately prior to the dive, the diving supervisor should conduct a "pre-dive inspection" of the diver and the equipment he is using.
11. Immediately after the dive, the diving supervisor should conduct a "post-dive inspection" of the diver and the equipment he used.
12. Only equipment that meets Navy approved specifications and is known to have been properly maintained and is in good operating condition shall be used.
13. Only gases that are known to have been supplied from a source that frequently conducts tests for impurities shall be used.
14. Divers shall not fly to cabin altitudes in excess of 18,000 feet or undergo recompression chamber ascents above this altitude equivalent within 12 hours following a SCUBA dive in excess of 30 feet or equivalent recompression chamber descent.

2. Open Circuit Precautions.

1. The apparatus shall never be charged with oxygen.
2. The apparatus shall always be charged

with clean air from a known source.

3. The cylinders shall be charged to the full pressure rating.
4. The cylinder pressure shall be determined immediately before a dive.
5. No dive shall be made without an adequate air reserve mechanism.

3. Closed Circuit Precautions.

1. The apparatus shall never be charged with any gas except oxygen.
2. Fresh absorbent shall always be used in the canister.
3. Oil shall never be used on the pressure fittings.
4. Air shall be purged from the lungs and breathing system before starting a dive.

4. Semi-Closed Circuit Precautions.

1. The apparatus shall always be charged with a standard mixture.
2. Fresh absorbent shall always be used in the canister.
3. The injection shall be carefully set to the proper flow for the depth anticipated.
4. The maximum depth specified for the mixture in use shall not be exceeded.
5. Divers shall be constantly alert for failure of the exhaust valve to bubble.
6. The differential pressure gage shall be checked at frequent intervals to insure original gas flow is maintained during the dives.

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4. Single Portable Ladders

a. DEFINITION. A single portable ladder is a ladder of one section which may be used at various locations.

b. LENGTH. Single portable ladders over 30 feet in length shall not be used.

c. ANGLE. When a portable ladder is placed against the wall or other fixed object, unless the ladder is securely fastened or a man is holding it, the base should be one-fourth the ladder length from the vertical plane of the top support. Where the rails extend above the top landing, ladder length to the top support only is considered.

d. BACK CLEARANCE. The clearance back of a ladder should always be sufficient to obtain a secure foothold on the rungs. Clearance of at least 6 inches is recommended.

e. FRONT CLEARANCE. The clearance space in front of the ladder should be such that it will not be necessary to assume a cramped or unnatural position when climbing. Front clearance of at least 30 inches is recommended.

f. NONSLIPPING BASE. Portable ladders, where used on smooth floors or sloping surfaces should be equipped with nonslipping bases, or otherwise secured to prevent displacement.

g. SPLICING. Single ladders which were not constructed to be used as sectional ladders should not be spliced together to form a longer ladder, unless such splicing together will provide and maintain the strength and rigidity required for a longer ladder.

5. Fixed Ladders

a. DEFINITION. A fixed ladder is a ladder fastened to a structure in a permanent position.

b. FASTENINGS. Fixed ladders shall be securely held in place by top, bottom, and intermediate fastenings as required.

c. CLEARANCE. Vertical ladders shall have a clear distance of at least 6½ inches from back of the rung or cleat to the nearest permanent object. Climbing clearance should be at least 30 inches from face of rungs to the nearest obstruction.

d. SLOPING LADDERS. Sloping ladders which require climbing on the under side of the ladder shall not be used.

e. LANDING PLATFORMS. Rails of ladders fixed to top landings should extend a distance of at least 36 inches above the landing. Rungs above the landing shall be omitted when it is necessary to pass through the ladder. Landing platforms shall be provided where a person must step a greater distance than 14 inches from ladder to roof, tank, etc.

f. PLATFORM INTERVALS. Landing platforms shall be provided for fixed ladders exceeding 30 feet in length at intervals of 30 feet or fraction thereof. The ladder sections shall be offset each from the other and connected by a landing platform. The top rung of any section of fixed ladder shall be at the level of or above the adjacent landing platform. On stacks or tanks the offset provision need not apply.

g. METAL CAGES. Metal cages extending from a point 7 feet above the base should be provided for all permanently fixed external and internal ladders more than 20 feet in height where such ladders are employed in regular service. Metal cages are not required where a ladder climbing safety device in accordance with Article 18306.6 is provided.

6. Extension Ladders

a. DEFINITION. An extension ladder is a ladder consisting of two or more sections traveling in guides or brackets so arranged that it may be adjusted to different lengths.

b. SPECIFICATIONS. Extension ladders shall not have more than two sliding sections. No extension ladder exceeding 60 feet in length when extended shall be used.

c. ANGLE. Extension ladders should be raised vertically, locked, and then placed at the same angle as single ladders. (See 07111-4c).

d. OVERLAPPING PORTIONS. Extension ladders shall be so constructed that, when locked in any position, rungs of the overlapping portions of each section will be opposite each other and of strength equal to a ladder with continuous side rails.

e. EXTENT OF OVERLAP. A lap of 3 feet shall be maintained for ladders up to 38 feet of extension length; 4 feet for ladders 38 to 44 feet; and 5 feet of lap for ladders 44 feet of extension length.

7. Stepladders

a. DEFINITION. A stepladder is a ladder having treads and so constructed as to be self-supporting.

b. LENGTH. Stepladders longer than 16 feet shall not be used.

c. FULLY OPEN. Stepladders shall be fully opened before anyone steps on them.

d. USED AS PLATFORM. A stepladder shall not be used as a working platform.

e. TOOLS. Tools shall not be left on top of stepladders, unless tool holders are provided.

f. STRENUOUS ACTION. Stepladders shall not be used when strenuous action on the part of the workmen is required. Under those circumstances there is danger of turning the ladder over.

8. Sectional Ladders

a. DEFINITION. A sectional ladder is a ladder consisting of two or more sections so constructed that the sections, when combined, will function as a single ladder.

b. SPECIFICATIONS

1. Sectional ladders longer than 30 feet shall not be used.

2. The bottom and intermediate sections of sectional ladders should not exceed a length of 6½ feet, and the top section should not exceed a length of 9 feet.

3. The connection joint of sectional ladders shall not be less than 1 foot and shall fit closely without binding or unnecessary play.

c. ANGLE. Sectional ladders shall be placed for use at the same angle as single ladders. (See 07111-4c).

9. Trestle Ladders and Extension Trestle Ladders

a. DEFINITIONS

(1) *Trestle Ladder.* One consisting of two single ladders hinged at the top to form equal angles.

(2) *Extension Trestle Ladder.* One consisting of a trestle ladder with an additional single ladder which is adjustable vertically and pro-

vided with a lock to keep it in place.

b. DIMENSIONS PERMISSIBLE. Trestle ladders and the base sections of extension trestle ladders shall be limited to 20 feet in height. The extension section of extension trestle ladders shall not exceed 20 feet.

c. SUPPORT FOR SCAFFOLD. Trestle and extension trestle ladders shall be so spread that the width of the trestle at the bottom, inside to inside, is equal to or greater than 5½ inches per foot of ladder length.

d. LOCKING DEVICE. The locking device or spreader used to hold the front and back sections securely in an open position and each pair of side rails rigidly parallel to one another must always be secured in its place when using the extension ladder. Also, the locking device for securing the extension section to the base must be utilized.

07112 WHEELBARROWS

1. Handles. Wheelbarrows with cracked or broken handles shall not be used.

2. Wheels. Twisted and out-of-round wheels shall be repaired or discarded.

3. Knuckle Guards. When wheelbarrows are used in narrow passageways, gloves or knuckle guards should be used.

4. Balancing Load. Wheelbarrow loads shall be balanced carefully with the center of the weight placed well forward to save lifting strain.

5. Lifting With Leg Muscles. When picking up a loaded wheelbarrow, the knees should be bent and the lifting done with the leg muscles.

6. Pulling Prohibited. Wheelbarrows should always be pushed, *not pulled*.

7. Running. Workmen shall never run with empty wheelbarrows in an upright position. This practice leads to serious injury from stumbling and falling.

8. Overloading. Wheelbarrows should not be overloaded, especially when used on ramps.

9. Leaving in Hazardous Spot. Wheelbarrows shall never be left in such a position that they can readily tip over or fall and shall never be left where persons or traffic can run into them.

Chapter 9

WEIGHT HANDLING AND CONSTRUCTION EQUIPMENT

Section I

GENERAL

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Subsection A

OPERATING RULES

09101 DEFINITION AND SCOPE

1. Equipment. "Weight-handling Equipment (Heavy)" as referred to in this section, includes crawler and motor drawn cranes, gantry cranes, portal cranes, tower cranes, hammerhead cranes, overhead traveling cranes, floating and wall cranes, locomotive cranes, derricks, hoists and elevators, and crushing, mixing, batching, and paving equipment. It does not include fork lifts, straddle carriers, and pallet trucks; for safety precautions covering the operation of such equipment, see chapter 2.

2. References. Precautions for railroad and automotive equipment are to be found in chapter 4.

09102 PRINCIPAL CAUSES OF ACCIDENTS

1. Personnel. About 80 percent of all accidents involving equipment used in construction work and weight-handling are caused by unsafe practices of operating, maintenance, and other personnel involved in the operation of the equipment. It is possible for these personnel to perform their tasks on or about the equipment in an unsafe manner many times over a long period without accident. Eventually they become convinced that their unsafe practices actually are safe. Inevitably, their continued violation of the safety rules results in accidents. The body of safety rules in this field has been developed through the investigation and analysis of thousands of accidents. Full compliance with the rules is essential.

2. Unsafe Practices. The predominant unsafe practices and hazardous conditions in the operation of heavy construction equipment are listed below. Operators of all such equipment should study this list carefully, noting particularly the hazards connected with their own work. They should also heed seriously the instructions and warnings of their supervisors regarding safe practices to be followed during operation, making every effort to avoid accidents from any of these 14 major causes:

1. backing and turning machines, swinging booms, lowering buckets, and similar operations without looking, warning, or signaling;
2. getting on and off equipment carelessly while it is in operation, or riding equipment when not authorized to do so;
3. operating equipment with defective brakes, clutches, cables, or other improperly functioning parts;
4. working or walking under skips, buckets, or loads;
5. failing to adjust controls properly before attempting to crank an engine;
6. oiling, adjusting, or repairing equipment while it is in operation;
7. using equipment with unguarded or inadequately guarded engine fans and other dangerous moving parts;
8. failing to use personal protective devices

- or clothing such as goggles, safety shoes, gloves, and hard hats;
- 9. failing to properly block equipment or heavy parts while repairing equipment;
- 10. operating equipment in a thoughtless or unsafe manner, such as moving too fast over rough ground or working too near the edge of a soft fill;
- 11. operating cranes too close to power lines without adequate watches and supervision;
- 12. failing to secure equipment, brakes, booms, and movable parts before repairing, leaving, or moving the machine;
- 13. poor housekeeping either on the equipment itself or in the operating area;
- 14. overloading equipment.

09103 OPERATING

1. Qualification of Operators. Operators of construction and weight-handling equipment shall be tested and licensed in accordance with the applicable requirements of *NAVDOKS P-306, Testing and Licensing of Construction Equipment Operators*. An apprentice or license applicant shall operate equipment only under the direct supervision of a licensed operator.

2. Physical Fitness. An operator who is not physically able or mentally alert shall not be permitted to start work with any piece of equipment.

3. Inspection. A frequent and regular inspection should be made of all machines. A well-maintained machine is usually a safe machine. All controls such as steering mechanism, brakes, and operating clutches shall be tested by the operator before any work is begun on a new shift. If any of these do not operate properly, they should be adjusted or repaired before any load is moved.

4. Grease. Good housekeeping is a prime necessity for safe and efficient operation. An accumulation of grease on a machine can cause falls and invite fires.

5. Refueling. Refueling of gasoline or diesel-operated equipment shall never be done while it is in operation. Frequent inspection of fuel lines and tanks for leaks will prevent fires as well as loss of fuel.

6. Gasoline Safety Cans. When transporting gasoline from general supply to equipment in 5-gallon quantities, safety cans shall be used. If tank truck service is not available, gasoline in quantities in excess of 5 gallons shall be transported in steel drums. All bungs shall be tight, and the drum itself checked for soundness. When dispensing gasoline from drums an approved pump should be used.

7. Leaving Machine. An operator shall never leave his machine while the engine is running.

8. Interrupting Work. Upon completion of a work shift, the bucket, dozer blade, etc. shall be rested on the ground, and the brakes and clutches set as recommended by the manufacturer.

9. Guarded Parts. All belts, gears, shafts, clutches, drums, fly-wheels, chains, and other reciprocating or rotating parts of equipment shall be adequately guarded.

10. Removing Guards. Guards, safety appliances, or any other safety devices shall not be removed or made ineffective except for the purpose of making adjustments or repairs, and then only after the power has been shut off. These guards and devices must be replaced immediately after completion of the needed repairs and adjustments.

11. Adjusting Machines. No one shall ever attempt to repair, clean, oil, or grease any part of the equipment while it is in motion.

12. Signals. Adequate warning devices and signals shall be installed on all mobile equipment.

13. Lighting. Adequate illumination must be provided for any night operation.

14. Designated Use of Machine. The use of a machine for any purpose other than on the work for which it was designed is both unsafe and inefficient and is prohibited.

15. Color Code. All Navy construction, fire fighting, railroad, utility, and weight-handling equipment shall be painted in accordance with the instructions contained in the Navy Department Color Safety Code: "The Application of Color to Shore Establishment." District Public Works Officers shall see that all such equipment

explosive and shall be carefully guarded against. No device or attachment facilitating or permitting mixture of air or oxygen with combustible gases prior to consumption, except at the burner or in a standard torch or blow pipe, shall be allowed unless approved for the purpose.

6. Mixing Gases. No one shall mix or attempt to mix different fuel gases in one cylinder nor mix any fuel gas with oxygen in one cylinder.

7. Use for Other Purposes. No one shall use a container for any purpose other than that for which it was intended.

8. Safety Devices. No one shall tamper with safety devices in cylinders or valves.

9. Assigned Locations. Keep all cylinders in definitely assigned locations that are:

1. well ventilated and away from corrosive chemicals and fumes;
2. away from radiator or other source of heat or fire; in summer, away from direct rays of the sun;
3. away from elevators, stairs, or gangways;
4. free from danger of being knocked over or damaged by heavy objects passing or falling;
5. where they cannot form part of an electric circuit;
6. away from combustible material, especially grease and oil;
7. far enough away from the actual welding or cutting operations so that sparks, hot slag, or flame will not reach them;
8. on or above the weather deck.

10. Securely Fastened. Cylinders in use or in stores or cargo shall be securely fastened to prevent shifting or falling under any weather conditions.

11. Confined Spaces. When welding or cutting is being performed in any confined space with difficult means of exit, the gas cylinders and heavy welding or cutting equipment shall be left on the outside.

12. Protection From Ice. Cylinders in the open should have valves and safety devices protected against accumulations of ice and snow. Warm (not hot) water shall be used to thaw ice in cylinder valve outlets.

13. Excessive Heat. In summer, cylinders in the open shall be screened from the direct rays of the sun to protect against excessive temperature rises. (The maximum temperature to which cylinders should be subjected is 130° F. Higher temperatures may cause dangerous pressure increases.)

11202 HANDLING OF CYLINDERS

1. Use of Cradles, Racks, Platforms. When loading or transferring cylinders, especially when using a crane or derrick, the cylinders shall be secured in a cradle, boat, suitable platform, rack, or special container (such as a sand bag). Cargo nets, rope, or chain slings should not, and electromagnets must not be used for this purpose. Valve protecting caps shall be in place during such operations.

2. Do Not Drag or Slide Cylinders. Cylinders moved by hand should be tilted and rolled on their bottom edges without dragging or sliding. Cylinders shall not be dropped or struck, and they shall not be permitted to strike each other violently.

3. Do Not Use as Roller or Support. Cylinders shall not be used as rollers or supports especially for welding or cutting operations, even if they are thought to be empty.

4. Remove Regulators Before Moving. Unless cylinders are secured in a special rack, regulators shall be removed and valve-protection caps should be put in place before cylinders are removed.

5. Rough Handling. All cylinders shall be handled carefully. Rough handling, knocks, or falls are likely to damage the cylinder, valve, or safety devices and cause leakage. Dropping or careless handling can break off a cylinder valve, and a sudden release of oxygen from a full cylinder can cause it to take off like a rocket.

6. Use of Hand Truck. Wheeled hand trucks for transporting and holding cylinders while welding or cutting are not recommended for shipboard use unless the commanding officer considers that their use will expedite operations. If used, the truck shall be of substantial design as follows:

a. FASTENED TO BULKHEAD. The truck shall be securely and firmly fastened to a bulkhead

or stanchion to prevent shifting or falling under any weather conditions.

b. RIGID FRAMES. The frame shall be rigid enough to permit handling with tackle.

c. HANDLES. Grips on handles shall end in a line vertical with the aft side of the wheels to facilitate fastening to a bulkhead.

d. SIDES. Platforms shall be fitted with sides to prevent cylinders from sliding off.

11203 CYLINDER VALVES

1. Protection Cap. Valve protection caps are designed to protect valves from damage. Before raising cylinders from a horizontal to a vertical position, the cap should be properly in place, the cap should be turned clockwise to see that it is hand-tight, then the cylinder should be raised by grasping the cap. Hooks of line through valve protection caps shall not be used for lifting cylinders from one vertical position to another. Bars shall not be used under cylinders and particularly not under valves or valve-protection caps to pry cylinders loose when frozen to the ground or deck or otherwise fixed; the use of warm (not boiling) water is recommended. Valve-protection caps should always be in place except when cylinders are in use or connected for use.

2. Open Valves Slowly. Cylinder valves shall always be opened slowly.

3. Never Repair Valves. Never tamper with nor attempt to repair cylinder valves. If trouble is experienced, indicate on a "defective" tag the nature of the trouble and return the cylinder to the supplier.

4. Do Not Force Valves. Do not use a hammer or a wrench to open cylinder valves. If valves cannot be opened by hand, tag them as defective and in need of repairs before recharging.

5. When the Oxygen Cylinder Is in Use. The valve should be opened at least one full turn, preferably all the way, to prevent leakage around the valve stem. Avoid complete removal of stem from a diaphragm type valve (it might be lost or dirt might enter the mechanism).

6. Closing Valves. Valves shall be closed

under the following conditions:

1. before moving cylinders;
2. when work is finished;
3. when cylinders are "empty."

11204 FUEL-GAS CYLINDERS

1. Vertical Position. Acetylene and liquefied fuel-gas cylinders shall be placed with valve-end up whenever they are used. They should also be stowed in this position and not allowed to lie on their sides. If horizontal stowage is necessary, cylinders must be in vertical position 48 hours before using. Otherwise acetone in which the acetylene is dissolved will be drawn out with the gas.

2. Leaking Cylinders. If a leak develops at a fuse plug or elsewhere on a cylinder, it shall be removed to the weather well away from any source of ignition, the cylinder valve slightly opened, and the fuel gas allowed to escape slowly. A warning shall be placed near this cylinder not to approach it with a lighted cigarette or other source of ignition. Such a cylinder shall be plainly tagged as defective and in need of repair before refilling.

3. Leaking Around Valve Stem. If, when the valve on a fuel gas cylinder is opened, there is found to be a leak around the valve stem, the valve should be closed and the gland nut tightened. If this does not stop the leak, the use of the cylinder should be discontinued. The cylinder shall be plainly tagged as defective and in need of repairs before using or recharging. If the need to use the cylinder is very urgent, the leak can probably be stopped by opening the valve all the way; but this should be done only when emergency conditions requiring quick closing of the cylinder valve are not likely to occur.

4. Leaks in Piping. Tests for leaks of any piping system or apparatus shall be made with soapy water. Use grease-free soap. **NEVER EMPLOY FLAMES TO DETECT LEAKS.**

5. Opening of Valve. An acetylene cylinder valve open $\frac{1}{4}$ to $\frac{1}{2}$ turn will permit an adequate flow of gas; and in order that the valve may be turned off quickly in case of

are kept intact and no smoking, sparks, or flames shall be permitted in the immediate vicinity of such vents. The flame arresters shall be kept free from paint and accumulations of soot or lint.

17115 FIRE FIGHTING EQUIPMENT

Specifications and instructions relative to the care, use, location, etc., of fire-extinguishing equipment are given in Bureau of Ships Manual, Chapter 93 (afloat), and in the United States Navy Structural Fire Fighting Manual (ashore), Opnav-P415-106.

17116 EXTINGUISHING FIRES

1. Methods. An oil or hydrocarbon fire can best be extinguished by smothering and exclusion of oxygen. Foam extinguishers and car-

bon dioxide are the preferred extinguishers. Chemicals or water in the form of fog may be used. Sand and steam are also effective.

2. Fire in Adjacent Space. In the event of fire in an adjacent space, the sprinkler system, if provided and manually controlled, should be placed in operation so that the drums and structures may be thoroughly drenched during the continuation of the fire. On shipboard the drainage pumps should be operated so as to carry away the water. Where no sprinkler system is provided and steam smothering is available, the space containing gasoline should be kept sealed and the steam smothering turned on. If sprinkling and steam smothering are not available, fog nozzles attached to hoses from fire plugs should be used for drenching the drums and structures.

Subsection C

HEALTH HAZARDS

17131 TOXIC HAZARD

Petroleum fuel vapors may cause anesthetic effects when inhaled. Inhalation of atmospheres containing 0.07 to 0.28 percent by volume of gasoline vapors (equivalent to about 5 to 22 percent of the lower explosive limit) may cause slight dizziness in some individuals after 3 minutes exposure; 1.1 to 2.2 percent causes severe dizziness after 3 minutes, and inhalation of 2.2 to 2.6 percent by volume causes intoxication after 10 to 12 breaths. Longer exposure or greater concentrations may cause unconsciousness or death.

1. Permissible Limit. The maximum permissible concentration of petroleum vapors in which it is safe for personnel to work an 8-hour day is 500 parts per million (0.05 percent by volume). Since the lower explosive limit is 1 to 1¼ percent for most fuels, it should be remembered that the concentration of vapors which can be tolerated by personnel is far below that required to produce explosive mixtures with air.

2. Symptoms. First symptoms of exposure to toxic vapors are headaches, nausea, and dizziness. If such symptoms are noted, they should

be taken as warning of the presence of dangerous amounts of vapors in the air. Recovery from these early symptoms is usually prompt after removal to fresh air. However, if men are overcome by vapors, they should receive immediate medical attention. First aid consists of prevention of chilling and of the application of artificial respiration if breathing has stopped.

17132 LEAD POISONING

1. Tetraethyl Lead. The toxicity of heavy concentrations of vapors from gasoline or other fuel is increased if it contains tetraethyl lead, added for antiknock purposes. This lead compound may be inhaled with the fumes or may enter the body through the mouth or by absorption through the skin and is very poisonous.

2. Contaminated Tanks. No tank used for leaded gasoline shall be assumed to be free from the hazard of lead poisoning until the tank has been thoroughly cleaned, even though the combustible gas indicator shows that it is free of gasoline vapor. Special protective clothing and a fresh air hose mask must be worn until such time as the tank is declared lead free.

3. Repeated Exposure. Lead poisoning may result from repeated exposure to gasoline vapors in an enclosed or inadequately ventilated area where leaded gasoline has been spilled in considerable quantity. There is also danger of lead poisoning from fumes given off by stoves or other gasoline burning equipment in which leaded fuel is used. Therefore a deleading device should be used and adequate ventilation should be insured. If operating personnel are exposed persistently to leaded gasoline, they should be rotated on the job in order to limit the period of individual exposure.

17133 INJURY TO SKIN AND EYES

1. Contact. Gasoline may cause skin irritations if allowed to remain in contact with the skin, particularly under soaked clothing or gloves. Clothing or shoes through which gasoline has soaked should be removed at once. Gasoline should be washed from the skin with soap and water. Repeated contact with gasoline removes the protective oils from the skin and causes drying, roughening, chapping, and cracking, and in some cases infections of the skin which may become serious.

2. Gloves. Oil-resistant rubber gloves should

be worn as protection by persons handling petroleum products.

3. Gasoline as Cleaner. Gasoline shall not be used for cleaning purposes under any circumstance.

17134 SWALLOWING GASOLINE

If a person swallows gasoline, first aid should be given immediately. Giving the victim a large quantity of warm, salty water to drink in order to induce vomiting is an effective aid. Medical attention should be secured immediately.

17135 ENTERING TANKS

1. Installations Ashore. No person shall be required or permitted to enter a tank which has contained liquid petroleum fuel except under the conditions and observing the precautions prescribed in NAVDOCKS P-342, *Fuel Storage Tank Cleaning at the Shore Establishment (Finished Product Tanks)*.

2. Installations Afloat. No person shall be required or permitted to enter a storage tank or storage space which has contained liquid petroleum fuel except under the conditions and observing the precautions prescribed in Chapter 92, *Bureau of Ships Technical Manual*.

in the superstructure are not subjected to hazardous levels of R-F radiation.

5. All personnel shall observe *R-F Hazards* warning signs which point out the existence of R-F radiation hazards in a specific location or area.
6. Minimum safe distance from radar antennas shall be maintained by all per-

sonnel. The minimum safe distance from specific radar antennas and the maximum exposure time within these distances under certain modes of operation are listed in the table below. These distances and times are valid only when personnel are in or near the center of the main beam of the antenna.

Minimum distances and maximum exposure time
(Distances in feet)

Radar	Fixed beam ¹	Scanning ²	Rotating ²	Scanning and Rotating ²	Max. exposure time in sec. inside fixed beam distance ³
AN/BPQ-1.....	27	25	0	0	2
AN/BPQ-2:					
Guidance.....	45	—	—	—	1
Search.....	65	—	8	—	0.5
AN/BPS-1.....	5	—	0	—	12
AN/BPS-2.....	0	—	0	—	30
AN/BPS-4.....	17	—	0	—	3
BN/BPS-9.....	3	—	0	0	25
AN/FPS-8.....	21	13	0	0	12
AN/MPS-4.....	34	—	0	—	12
AN/SPG-34.....	0	—	—	—	30
AN/SPG-48.....	54	—	—	—	12
AN/SPG-49.....	590	—	—	—	1.5
AN/SPG-49A, B.....	590	—	—	—	1.5
AN/SPG-50.....	0	—	—	—	30
AN/SPG-51:					
cw.....	625	—	—	—	3
track.....	150	—	—	—	12
AN/SPG-51B:					
cw.....	1,030	—	—	—	1.5
track.....	150	—	—	—	12
AN/SPG-52.....	21	—	—	—	5
AN/SPG-53, 53A.....	50	—	—	—	25
AN/SPG-55:					
track.....	70	—	—	—	12
capture.....	30	—	—	—	6
AN/SPG-55A:					
cw.....	750	—	—	—	3
track.....	70	—	—	—	12
capture.....	30	—	—	—	6
AN/SPN-5.....	4	—	0	—	25
AN/SPN-6.....	140	—	0	—	12
AN/SPN-8.....	10	0	—	—	20
AN/SPN-10.....	0	—	—	—	30
AN/SPN-12.....	13	—	—	—	15
AN/SPQ-5, 5A.....	0	0	—	—	30
AN/SPS-2.....	380	—	0	—	12
AN/SPS-4.....	13	—	0	—	6
AN/SPS-5.....	3	—	0	—	28
AN/SPS-6.....	13	—	0	—	28
6C.....	14	—	0	—	6
AN/SPS-7.....	0	—	0	—	30
AN/SPS-8.....	43	0	0	0	28
8A.....	84	44	0	0	15
8B.....	220	0	0	0	29
AN/SPS-10.....	15	—	0	—	5
AN/SPS-12.....	20	—	0	—	12
AN/SPS-13.....	620	—	0	—	1.5
AN/SPS-17, small antenna.....	36	—	0	—	3

See footnotes at end of table.

Minimum distances and maximum exposure time—Continued
(Distances in feet)

Radar	Fixed beam ¹	Scanning ²	Rotating ²	Scanning and Rotating ²	Max. exposure time in sec. inside fixed beam distance ³
AN/SPS-17A, large antenna	12	—	0	—	29
AN/SPS-21	0	—	0	—	30
AN/SPS-26	180	0	0	0	10
AN/SPS-28	0	—	0	—	30
AN/SPS-29	35	—	0	—	3
AN/SPS-30	840	320	0	0	5
AN/SPS-31	84	—	0	—	12
AN/SPS-32	0	0	—	—	30
AN/SPS-33	*0-20 340-770	20	—	—	29
AN/SPS-35	0	0	0	0	30
AN/SPS-36	0	—	0	—	30
AN/SPS-37, small antenna	70	—	20	—	1.5
AN/SPS-37A, large antenna	40	—	0	—	6
AN/SPS-38	80	—	—	—	15
AN/SPS-39	180	0	0	0	10
AN/SPS-40	60	—	0	—	6
AN/SPS-42	180	0	0	0	10
AN/SPS-43, small antenna	70	—	20	—	1.5
AN/SPS-43A, large antenna	40	—	0	—	6
AN/SPW-2	0	0	0	0	30
AN/TPS-1D, 1G	30	—	0	—	15
AN/UPX-1, 1A	0	—	—	—	30
AN/UPE-5	0	—	—	—	30
AN/UPX-12	0	—	—	—	30
MK-13	0	—	—	—	30
MK-25, MOD 3	0	—	—	—	30
MK-35	0	—	—	—	30
SA Series	0	—	0	—	30
SC Series	0	—	0	—	30
SK-1	0	—	0	—	30
SK-3	0	—	0	—	30
SR-a and SR-b	0	—	0	—	30
SR-3, 3a, 3b	0	—	0	—	30
SR-3c	9	—	0	—	10
SR-6	15	—	0	—	5
SS Series	2	—	0	—	20
SV-3	17	—	0	—	15

*The r-f hazard zone for the AN/SPS-33 radar extends from 0 to 20 feet and from 340 to 770 feet in the stationary main beam.

¹ Determination of the safe distance from radar antennas in fixed beam operations is based on a continuous exposure level not to exceed a power density of 10 Mw/cm².

² In determining the hazard distance for antennas rotating and/or scanning, either mechanically or electronically, an incident energy level of three hundred milli-joules per thirty second time interval is used. This is equivalent to continuous exposure to 10 Mw/cm².

³ The last column gives the exposure time inside the fixed beam distance equivalent to a continuous exposure to 10 Mw/cm² for 30 seconds.

NOTES:

A dash (—) indicates that the radar does not normally operate in this mode.

A zero (0) indicates that the radar is safe up to the swing circle of the antenna. It is not necessarily safe between the primary field and the reflector for the type of antenna.

18305 X-RAY RADIATION HAZARDS FROM HIGH VOLTAGE ELECTRONIC EQUIPMENT

When high velocity electron beams strike metal or certain other materials, X-rays are produced. The operation of some electronic devices depends on the acceleration of electrons, and when the accelerating voltage approaches or exceeds 15,000 volts the production of X-rays may become a hazard to personnel. Examples of such electronic devices are magnetrons, klystrons, thyratrons, cathode ray tubes and high voltage rectifier tubes. Currently, radars are about the only electronic equipment that use sufficient voltage on these devices to constitute a hazard. The X-rays produced by accelerating potentials on the order of 15,000 volts are not hazardous beyond a foot or so from the source and do not require elaborate shielding to make the device safe for nearby personnel. However, as the accelerating potentials become greater than 15,000 volts, the X-rays produced have much greater energy and the difficulty of providing adequate shielding increases appreciably.

a. SERVICING ELECTRONIC DEVICES THAT PRODUCE X-RAY HAZARDS. When performing preventive or corrective maintenance on electronic devices that produce hazardous X-ray radiation as an undesirable by-product, the following precautions should be observed by maintenance personnel:

1. Observe all warning signs on the equipment and all written safety precautions in the instruction manuals for the equipment that deal with X-ray hazards.
2. Do not jumper interlocks that permit the servicing of operating equipment with the protective X-ray shielding removed, unless such procedures are called for in the instruction manuals.
3. Be sure to replace all protective X-ray shielding when servicing is complete, so that operating personnel or others will not unknowingly be subjected to harmful X-ray radiation.
4. When bench testing X-ray producing electronic devices be sure that adequate X-ray shielding is provided to protect all personnel in the testing area.

5. Determine the latest safety precautions to be observed by maintenance personnel, including the use of the latest approved dosimeters, by consulting the ship's safety officer on shipboard or the industrial hygienist at shore installations.

18306 WORKING ON ANTENNAS

1. Cautions to Personnel. Division officers shall caution all men in their division not to venture or work close to an exposed radio or radio antenna unless it is first determined from the proper authority that the antenna is not and will not be energized. (See also article 18304.)

2. Working Aloft. Before any work may be done on antennas aloft, authorization must be obtained from the Commanding Officer. While antennas are energized by transmitters, men shall not be permitted to go aloft except by means of ladders and platforms rendered safe by grounded hand rails or similar structures (safety belts shall be worn when aloft to guard against falls). Before sending men aloft, except as noted above, the Commanding Officer shall direct the communication watch officer to secure the proper transmitters in order to render this area safe, and shall notify the engineering duty officer that men will be working in a prescribed area aloft in order that the engineering duty officer may take the necessary precautions to prevent the boiler safety valves from lifting. Until he has received a report from the communication watch officer that the proper transmitters are secured, the Commanding Officer shall permit no man to go aloft. After the work has been completed a report shall be made to the Commanding Officer, and his authorization must be obtained before the circuit is again energized.

3. Danger From Rotating Antennas. Radar and other antennas which rotate or swing through horizontal or vertical arcs may cause men working aloft to fall. Therefore, the motor switches which control the motion of these antennas should be secured or locked in the open position and suitably tagged before men are permitted to ascend or go within reach of the antenna.

Chapter 20

ORDNANCE

General, 20101

Ammunition Handling and Stowage, 20102

Service of Guns, Including Ammunition Supply, 20103

Precautions To Be Observed in Handling, Fuzing, or Inserting Detonators in Explosive Ordnance, 20104

Torpedoes, Torpedo Air Flasks and Accessories, 20105

Miscellaneous Ordnance Safety Precautions, 20106

20101 GENERAL

1. Scope. To avoid danger of casualties, the observance of the following safety precautions is mandatory. The Bureau of Naval Weapons shall be informed of any circumstances which conflict with these safety precautions or which for any other reason require changes in or additions to them.

2. Interpretation. When in doubt as to the exact meaning of a safety precaution, an interpretation shall be requested from the Bureau of Naval Weapons. Conditions not covered by these safety precautions may arise which, in the opinion of the commanding officer, may render further operation of the equipment unsafe. Under these conditions, nothing in these safety precautions shall be construed as authorizing such further operation.

3. Safety Devices. Safety devices provided shall always be used as designated to prevent possibility of accident, and shall be kept in good order and operative at all times. All instructions promulgated by competent authority to insure safe operation or handling of equipment shall be strictly observed.

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4. Safety Watch for Moving Units. Whenever any motion of power-driven unit is capable of inflicting injury on personnel or material not continuously visible to the person controlling such motion, the officer or petty officer who authorizes the unit to be moved by power shall, except at general quarters, insure that a safety watch is maintained in areas where such injury is possible both outside and inside the unit, and shall have telephone communication established and maintained between the station controlling the unit and the safety watch. These precautions are applicable to turrets, gun mounts, guns, directors, range finders, search-

lights, torpedo tubes, rocket launchers, and similar units. Under the conditions stated above, the station controlling shall obtain a report "all clear" from each safety watch before starting the unit. Each safety watch shall keep his assigned area clear and if unable to do so shall immediately report his unit fouled, and the controlling station shall promptly stop the unit until it is again reported clear.

5. Warning Signal. In turrets and enclosed mounts, a warning signal shall be installed outside the turret or mount; and whenever power train is used, except at general quarters, the officer or petty officer in charge of the turret or mount shall cause warning signals to be sounded before using power and at intervals during its use.

6. Changes in Material. Changes, modifications in, or additions to ordnance material, or other material used in connection therewith, shall not be made without explicit authority from the bureaus concerned.

7. Designated Use of Explosives. Except for explosive ordnance disposal operations and at research and development activities, no ammunition or explosive assembly shall be used in any gun or appliance for which it is not designated, nor shall any explosive device be manufactured or assembled for use in demonstrations, tests, or for any other purpose unless the justification for its use and the design of the device is submitted to the Bureau of Naval Weapons for prior approval.

8. Drill Ammunition. No other than drill ammunition shall be used for drill.

9. Safety Link. On guns equipped with hydro-pneumatic counter-recoil systems, the safety link, locking the gun to the slide, shall be connected up at all times except when firing or when testing and overhauling the

counter-recoil systems or when a battery is in a condition of readiness for action.

10. AA Firing. Except in action or when specifically authorized, antiaircraft guns shall not be fired at elevations greater than, or fuze settings less than, those prescribed in the current orders for Gunnery Exercises. When firing antiaircraft guns as such, all personnel not required to be exposed shall be kept under cover.

20102 AMMUNITION HANDLING AND STOWAGE

1. Supervision. As familiarity with any work, no matter how dangerous, is apt to lead to carelessness, all persons who may supervise or perform work in connection with the inspection, care, preparation, use, or handling of ammunition or explosives have the following responsibility:

1. They shall exercise the utmost care that all regulations and instructions are rigidly observed.
2. They shall carefully supervise those under them and frequently warn them of the necessity of using the utmost precaution in the performance of their work. No relaxation of vigilance shall ever be permitted.

2. Fueling Operations. Except in case of emergency, ammunition shall not be transferred during fueling operations.

3. High Temperature. All ammunition, explosives, and powder shall be protected from abnormally high temperature. If so exposed, they shall be handled in accordance with current instructions of the Bureau of Naval Weapons. Permissible maximum storage temperatures shall be prescribed by the Bureau of Naval Weapons.

4. Smokeless Powder

a. WHEN WET. Smokeless powder which has been wet from any cause whatever must be regarded as dangerous for dry storage. Such powder shall be handled in accordance with current instructions of the Bureau of Naval Weapons.

b. DECOMPOSED. Smokeless powder which

shows unmistakable signs of advanced decomposition shall be disposed of in accordance with current instructions of the Bureau of Naval Weapons.

5. Handling. To minimize the risk of fire, explosion, and damage to ammunition and its containers from accidental causes, ammunition shall be handled as little as practicable. As the action of denting thin-cased high-explosive ammunition is known to have caused detonation of the explosive in some instances, special care shall be exercised to insure that such ammunition is never struck, dropped, or bumped.

6. Defective Ammunition. Defective bomb type and thin-case ammunition shall be disposed of in accordance with current instructions of the Bureau of Naval Weapons.

7. Fuzed Projectiles

a. DROPPING. A fuzed projectile, whether in a container or not, if dropped from a height exceeding 5 feet shall be dumped overboard in a manner conforming with regulations for dumping ammunition at sea except when practicable to turn the projectile into a Naval Ammunition Depot. Such ammunition shall be handled with the greatest care.

b. STRIKING. Care must be used to avoid tapping or otherwise striking fuzed projectiles. This precaution is particularly applicable to attempts to loosen such a projectile in the cartridge case by repeated light blows of a mallet, unloading such a projectile wedged in the bore of a gun, and the striking of a projectile by the recoil of a gun or an ejected case.

8. Switches. The covers of switches, circuit breakers, etc., shall be kept securely closed while powder is exposed in the vicinity.

9. Magazines

a. CLEAN AND DRY. Magazines shall be kept scrupulously clean and dry at all times. Nothing shall be stored in magazines except explosives, containers, and authorized magazine equipment. Particular attention shall be paid that no oily rags, waste, or other for-

of the gun shall be carefully extracted and put aside, and no further attempt shall be made to fire such a cartridge.

20. Breech Plug Closing. In every case gun using primers with a percussion element, except those guns of the sliding-wedge type, the breech plug shall not be closed until the plugman is assured by actually feeling that the front face of the plug is free from any projections, such as a protruding firing pin or fused metal, in order to prevent discharge of the gun when the breech plug is swung to but not rotated.

21. Stowing Fired Cartridge Cases. In order to avoid danger from flammable gases, fired cartridge cases shall, before stowing below, remain in freely circulating open air for at least 10 minutes. If practicable they should be stored on their base.

22. Premature Opening Breech of Loaded Gun. Effective measures shall be taken to guard against prematurely opening the breech of a loaded gun, whether or not the gun is fitted with a salvo latch.

23. "Cease Fire" When Gun Is Loaded. If a gun is loaded at the order "cease fire"—

1. The gun shall be kept pointed and trained in a safe direction.
2. The breech mechanism shall be kept fully closed.
3. The gun shall normally be cleared by firing as soon as practicable.

24. Fuzed Projectile in Hot Gun. A loaded and fuzed projectile, seated in the bore of a gun that is hot from previous firing, presents a hazard, since detonation of the projectile is possible as a result of being heated. Whenever practicable, such projectile should be disposed of promptly by firing the round. Whether a gun is hot or cold, the risks attendant upon removing a loaded and fuzed projectile seated in the bore, by backing out, are considered unwarranted except in the case of guns for which existing instructions specifically prescribe this procedure.

25. Hangfire

a. POSSIBILITY OF ACCIDENT. The possibility of a serious accident due to opening the breech of a gun too soon in the case of a hangfire

demands the constant exercise of the utmost prudence and caution. A hangfire must be assumed to exist when:

1. An unsuccessful attempt has been made to fire the gun.
2. A charge remains in a bag gun, with the possibility of ignition by an undetected ember from the previous round.

b. PROCEDURE FOR FIRING. The following procedure shall be followed in the cases noted above:

1. Keep the gun pointed and trained in a safe direction.
2. Keep the breech mechanism fully closed.
3. Continue attempts to fire, if desired, re-priming bag guns provided such efforts do not involve any movement tending to open the breech.

c. PROCEDURE WHEN GUN IS NOT FIRED. If the gun is not fired under the above conditions:

1. Open the firing key and break the firing circuit elsewhere.
2. Unhook the firing lanyard, if detachable.
3. Remove the primer from the lock of a bag gun, using the primer tools supplied for this purpose, taking care to avoid danger from recoil or blowback. For this purpose, or for shifting primers, do not leave the firing lock open longer than necessary.
4. Wait a safe time after last attempt to fire before opening the breech. Bureau of Naval Weapons publications prescribe details including specific safe times varying from a few seconds to 60 minutes depending on hot or cold gun conditions, caliber and type, water cooling, and combat and non-combat situations. For example, to avoid cook-off explosion of ammunition in a hot gun, generally earlier opening of the breech provides maximum safety. U.S. Army technical manuals contain similar precautions for field guns ashore.

d. NEVER LEAVE A LOADED GUN. The crew shall never leave a loaded gun until the precautions in (b) and (c) 1 to 3 above have been carried out.

e. DISPOSING OF AMMUNITION. Ammunition

removed from a loaded gun shall be disposed of in accordance with current instructions of the Bureau of Naval Weapons.

26. Obstructed Line of Fire. Ships shall cease the firing of any gun whose line of fire is endangering any objects other than the designated target. These objects include friendly ships and aircraft and own ship's structure together with the mounts and launchers and their barrels, fixed or moving. This stipulation applies to objects in the vicinity of the firing point, throughout the trajectory and in the vicinity of the target. Turrets, mounts, guns and launchers which are not firing, while others are firing, shall be trained and elevated if manned, or secured if unmanned, in a manner that will provide the greatest amount of safety from the firing. This position of greatest amount of safety of the unmanned mounts will generally be that position which the firing cut-out mechanism cams of the firing mounts were cut to clear.

20104 PRECAUTIONS TO BE OBSERVED IN HANDLING, FUZING, OR INSERTING DETONATORS IN EXPLOSIVE ORD-NANCE

1. Armed Ammunition. Since it is not always possible to ascertain readily whether mines, depth charges, rockets, projector charges, and aircraft bombs have been inadvertently armed in storage or handling, all of these types, when fuzed or assembled with firing mechanisms, shall at all times be handled and treated as if armed, in strict conformity with the instructions for safeguarding against the inadvertent arming, firing, or launching of such ammunition.

2. Inserting Fuzes. Certain types of bombs, mines, depth charges, rockets, and projector charges are normally issued unfuzed. Fuzes shall not be inserted in such ammunition (nor in the case of fuzes having separate detonators, shall the detonators be inserted in the fuzes) until just prior to placing in ready stowage, or just prior to or after loading the ammunition on the racks, launchers, or projectors preparatory to dropping or launching. Such fuzing or inserting of detonators shall not be accomplished in or near a magazine or ready

service stowage, but may be accomplished in handling rooms or spaces specially designated for such purposes by competent authority. In general, fuzing or inserting of detonators shall be done on individual rounds isolated from other ammunition insofar as practicable.

3. Resetting Fuzes. Fuzes which have been set shall be reset to the safe position before sending them below.

4. Work Involving Fuzes and Firing Devices. Fuzes, firing mechanisms, or primer mechanisms for bombs, depth charges, rockets, projector charges, demolition outfits, or mines shall not, except as covered by special orders or current instructions of the Bureau of Naval Weapons, be removed, disassembled, repaired, or in any way altered.

5. Stowing Fuzes

a. NEAR EXPLOSIVES. Bombs, rocket heads, and projector charges, for which fuzes are issued separately, shall not be stowed with those fuzes installed in or near magazines containing explosives.

b. CONTAINING INTEGRAL DETONATORS. Fuzes issued separately for bombs, rockets, and projector charges, which contain integral detonators or other explosives components, shall be stored only in specially designated fuze magazines which shall not be located adjacent to magazines containing high explosives.

6. Stowing Detonators. Detonators which are not assembled integrally with fuzes shall be stored only in standard type detonator lockers located in approved places.

7. Removing Fuze-Arming Devices. Fuze-arming wires or devices shall not be removed from the unarmed position until just before releasing or firing. Safety pins or other devices requiring removal before flight, or firing, shall not be removed until the ammunition has been loaded in racks, projectors, or launchers and not until after the arming wire or device has been put in place. Bombs, mines, depth charges, rockets or projector charges not expended shall be made "safe" at the first opportunity in accordance with current instructions for the respective assemblies. When handling or unarming an accidentally armed fuze, the prescribed procedure shall be carefully followed.

8. Electronic Components, Including Electric Igniters, Detonators, and Fuzes. Electric igniters, primers, or detonators, electrically fired rocket and guided missile motors, electric or electronic ordnance fuzes, including VT fuzes, shall not be stowed in the same compartment with,

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4. Watch carefully the condenser pressure when starting; this will give you warning of any improper conditions.
5. Extreme care must always be exercised by refrigeration machine operators and mechanics to make sure that only the appropriate gas for the particular type of machine is introduced into the system.
6. When shutting down a compressor for overhaul or servicing, line fuses must be removed to prevent accidental starting which would jeopardize personnel working on or near the compressor.

3. Proper Use of Refrigerant Cylinders

a. CONNECTING TO SYSTEM. Refrigerant cylinders shall never be connected to the refrigerating system except when the system is being charged or drained.

b. FILLING CYLINDERS. If it becomes necessary to withdraw refrigerant from a system into cylinders, great care shall be taken to avoid overcharging such cylinders. The cylinders should be weighed before and after filling and checked against allowable weights stamped on them. If they are accidentally overfilled the excess should be allowed to escape immediately into a flowing water drain.

4. Inspection of Coils. The brine coils or expansion coil supports of refrigeration systems should be inspected at every defrosting period, or at least once a year, to see that they have not become corroded to an unsafe condition. Failure of these coil or pipe supports because of corrosion can damage the refrigeration system and seriously injure personnel.

5. Identifying Pipe Lines and Valves. For shore installations, refrigeration piping should be painted in accordance with "Color Code for Compressed Gas Cylinders and Piping," MIL Standard No. 101.

6. Refrigerator Doors

a. WALK-IN REFRIGERATORS. Each door, including anteroom doors, if any, on walk-in refrigerators or cold storage rooms shall be equipped with inside door handle or bump bar for releasing the door fasteners or to force the door open from within the refrigerator or cold

room. Doors fitted with locks shall be so arranged that the locks can be opened from the inside. Locks independent of inside-opening arrangements shall not be permitted. Appropriate instructions regarding emergency escape procedures shall be posted on the inside of the doors. Instructions shall be printed or painted in luminous colors and on material that withstands dampness and freezing temperatures for reasonable periods of time.

b. REACH-IN REFRIGERATORS. Reach-in type refrigerators and freezers which are not in use and are placed in locations accessible to children shall have the doors or latching devices removed.

25205 GROUNDED WALK-IN REFRIGERATORS (ADVANCED BASE TYPE)

1. Ground Metal Sheathing. Persons engaged in the operation and maintenance of advanced base type walk-in refrigerators shall make sure that the power and lighting circuits are grounded in accordance with the following criteria before commencing any work on the unit.

The lighting circuit raceway, receptacle and switch box, exposed metal part of lighting fixtures, refrigerating unit including motor frame, motor starter enclosure and motor switch box and generator neutral and/or building service neutral shall be connected to a permanent ground. All electrical lines to the refrigerator should be checked to assure that they are properly connected and that no condition exists where the conductors contact exposed metal parts of the refrigerator.

2. Principle of Grounding. Electrical equipment is grounded by being connected to the earth or to some extended conductive body which serves the same purpose. The frames of motors, electrical conduits, switchboards, etc., and certain parts of refrigerators are grounded as a safety measure to prevent their becoming electrically charged. Anyone touching an energized part of the grounded equipment will be saved from serious injury because the current will not be likely to flow through him to the ground and produce a shock, burn, or possible fatality.

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Supplement I

CLASSIFICATION GUIDE FOR HAZARDOUS MATERIALS

In accordance with instruction from the Secretary of the Navy (SECNAVINST 6260.3 of 24 September 1956) all materials should be labeled whether or not they are considered toxic, flammable, or explosive. This is desirable not only to prevent untoward incidents but also to conserve materials which might otherwise be discarded and wasted.

Background. The development of new chemical products and the introduction of new chemical processes make it mandatory that precautionary measures be taken during the handling of toxic and dangerous chemicals. Warning labels affixed to containers of hazardous chemicals are one of the most practical means of accomplishing this objective. Procedures herein are based on a composite of the procedures recommended by the Manufacturing Chemists' Association, the International Labor Organization, the American Conference of Governmental Industrial Hygienists, the Atomic Energy Commission, and the labeling programs at several naval activities.

Scope. This supplement, which will be revised periodically, is designed to implement the uniform labeling of all such materials throughout the Naval Establishment where distribution is made to the actual consumer (shop, office, or unit) and governs labeling of materials received from any supply source if such material is intended for ultimate use at the local activity. Included is the labeling of the original container and any other container to which the material may subsequently be transferred. The labels selected are designed to warn users of the potential dangers involved.

EXEMPTIONS

The following categories of labels are not covered by this order:

Materials being held in store for reshipment. Such material is labeled to comply with state and Federal laws depending upon the nature of

the material and whether the shipment is interstate or intrastate. In addition, procurement specifications require that materials be labeled in accordance with the *Warning Labels Guide* published by the Manufacturing Chemists' Association.

Chemicals and drugs used or dispensed by medical department pharmacies. Chemicals used by clinical or chemical laboratories. (The exempted laboratories will be those designated by the various bureaus, offices, and the Marine Corps.)

Explosives, fuels and compressed gases. These materials are adequately covered by current instructions.

RESPONSIBILITY

Chemical Control Committee. At each activity there should be established a Chemical Control Committee or equivalent thereof to administer the technical phases of the labeling program for the local activity and to make revisions as necessary to keep the program current. Directives should be prepared by the committee for promulgation by the commanding officer. These should be based on Bureau instructions and should be tailored to suit the needs of each activity. The size and nature of the activity will be major factors in determining whether this committee will be a formal organization composed of cognizant personnel, or whether it will consist of one individual to whom this additional responsibility is delegated.

The *supply officer* of each activity shall be responsible for proper labeling of all containers when issued on local requisitions. Containers held in store for shipment through interstate or intrastate commerce or aboard commercial or government-owned vessels shall not be labeled in accordance with this supplement.

Supervisory personnel shall be responsible for the proper labeling of any containers to which hazardous materials may be transferred after

issue by the supply department.

Cognizant management personnel shall institute a training program to familiarize employees with the labeling program, with emphasis on the significance of the color coding, the insignia, and key words on each category of label.

Bureau of Supplies and Accounts has initiated procedures to have the necessary labels stocked as General Stores items for use by all naval activities.

ADDITIONAL LABELING

It may be necessary on occasion for qualified investigators to work with new products before adequate chemical, physical, and toxicological data are available. To cover such cases, and such cases *only*, the following guide is suggested for preparing labels to be used during the period of investigation:

**(Name or description of product)
FOR INVESTIGATIONAL USE ONLY
STATEMENT OF KNOWN HAZARDS**

(Appropriate precautionary measures)

(Appropriate instructions in case of contact or exposure)

IMPORTANT! The chemical, physical and toxicological properties of this product have not been fully investigated and its handling or use may be hazardous.

EXERCISE DUE CARE

AVAILABLE LABELS

Pressure sensitive paper labels in accordance with the hazard classifications specified herein are available in Navy supply. Their form numbers and ordering information are given in NAVSANDA Publication 2002: *Navy Stock List of Forms and Publications*.

IDENTIFICATION OF HAZARDOUS MATERIALS

The various Navy Stocks Lists pertaining to chemicals, protective coatings, petroleum products, and others which contain hazardous materials designate (or will soon do so) for each item the applicable class of label as defined in this order.

LABEL CLASSIFICATION AND DESIGN

Hazardous materials fall into seven general classifications as defined below. The design, sizes, and colors of the applicable labels shall be in accordance with *Military Standard MIL-STD-755, Labels Containing Symbols For Packages And Containers For Hazardous Industrial Chemicals And Materials*.

Class 1—Fire Hazard (Flammable)

Any material known as flammable or combustible.

Class 2—Toxic and Fire Hazard

Any material which presents a combined hazard due to its flammability (Class 1) and its toxicity (Class 3).

Class 3—Toxic

Any material which may be harmful to persons coming in contact with the material or vapor, dust, fume, or mist given off from the material during utilization or processing. The injurious effects may arise from one exposure (acute) or from repeated exposures over a long period of time (chronic). The mode of entry into the body may be either through the respiratory tract or the skin. The oral route of entry is an uncommon route in the usual environmental exposure.

Class 4—Poisonous

A poison is commonly understood to be a material which will lead to fatal results in a short period of time when taken into the body. Oral intake is the primary mode of entry into the body, although other routes such as inhalation and absorption through the skin may produce the same effect as oral ingestion of some materials.

Class 5—Corrosive

Agents which in contact with tissues of the body surface will cause injury or destruction of those tissues.

Class 6—Radioactive Hazard

Hazardous materials which emit alpha, beta, gamma, or neutron radiation or which may give off dusts, fumes, gases, or vapors emitting these radiations.

Class 7—Fire Hazard-Oxidizer

Any material which readily furnishes oxygen for combustion and fire producers which react explosively or with evolution of heat in contact with many other materials.

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